

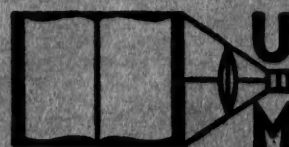
Vol. XVI

No. 9

DISSERTATION ABSTRACTS

*ABSTRACTS OF DISSERTATIONS AND
MONOGRAPHS IN MICROFORM*

UNIVERSITY MICROFILMS
ANN ARBOR, MICHIGAN: 1956



DOCTORAL DISSERTATION SERIES

Cooperating Institutions

Alabama Polytechnic Institute	University of Missouri
The American University	The University of Nebraska (including School of Education)
University of Arizona	The University of New Mexico (including School of Education)
University of Arkansas	New York University (including Graduate and Education Schools)
Boston University (Schools of Education and Theology)	North Carolina State College
Bradley University	Northwestern University
Brown University	University of Notre Dame
Bryn Mawr College	The Ohio State University
The University of Buffalo	The University of Oklahoma
University of Cincinnati (including Teachers College)	Oregon State College
The Claremont Graduate School	University of Pennsylvania
Clark University	The Pennsylvania State University
University of Colorado	University of Pittsburgh
Colorado Agricultural and Mechanical College	Polytechnic Institute of Brooklyn
Colorado State College of Education	Princeton University
Columbia University	Purdue University
The University of Connecticut	Rensselaer Polytechnic Institute
Cornell University (including Cornell Medical College)	Rutgers University
The University of Florida	St. Louis University
The Florida State University	University of South Carolina
George Peabody College for Teachers	Stanford University
University of Georgia	Syracuse University
The Hartford Seminary Foundation	Temple University
University of Houston	The University of Tennessee
University of Illinois (including Chicago Professional Colleges)	North Texas State College
Indiana University (including the Graduate Schools of Business, Education and Music)	Tulane University
State University of Iowa	University of Utah
University of Kansas	Vanderbilt University
Kansas State College	University of Virginia
Lehigh University	Virginia Polytechnic Institute
Louisiana State University	State College of Washington
University of Maryland	Washington University
University of Michigan	University of Washington
Michigan State University	Wayne University
University of Minnesota	The University of Wisconsin
	Yale University
	Yeshiva University

Vol. XVI

No. 9

DISSERTATION ABSTRACTS

*ABSTRACTS OF DISSERTATIONS AND
MONOGRAPHS IN MICROFORM*

UNIVERSITY MICROFILMS
ANN ARBOR, MICHIGAN: 1956

LITHOPRINTED IN THE UNITED STATES OF AMERICA BY
CUSHING - MALLOY, INC., ANN ARBOR, MICHIGAN, 1956

INTRODUCTION

This year for the first time *Dissertation Abstracts* will carry, as the 13th issue of Volume XVI, an index to all doctoral dissertations published in the United States and Canada. This issue will be titled *Index to American Doctoral Dissertations*, and will be a continuation of *Doctoral Dissertations Accepted by American Universities*.¹ The joining of these two reference works makes it possible for librarians to have an integrated bibliographical research tool relating to doctoral dissertations under one cover.

Dissertation Abstracts will continue to provide abstracts of dissertations by recipients of doctoral degrees from graduate schools cooperating with University Microfilms in the publication of complete dissertation texts on microfilm, on Microcards, or as microprint. At the end of each abstract will be found an indication of the number of pages in the original typescript and the Library of Congress card number, for the convenience of scholars and research workers. In some instances *Dissertation Abstracts* will be found to be an adequate substitute for the published dissertations.

The *Index to American Doctoral Dissertations* will be a complete indexed listing of dissertations by students who were granted doctoral degrees during the previous academic year, and including those abstracted in *Dissertation Abstracts*, arranged by degree-granting institutions under appropriate subject headings. An alphabetical author index will be included.

The tabular material which has been an established part of its predecessor volume will be included in full, so arranged that statistical summaries can be maintained with no break in continuity.

It is hoped that those who use *Dissertation Abstracts* will continue to make suggestions for its improvement, as these are vital to its continued life and growth. Several suggestions for changes in the headings used for indexing purposes have been received, and a committee of the Association of Research Libraries is reviewing the indexing system at the present time as a result of these suggestions.

¹Arnold H. Trotter and Marian Harman, (eds.), *Doctoral Dissertations Accepted by American Universities*. (New York: H. W. Wilson Co., 1933-1955.)

Back Issues

Libraries wishing to complete their files of DISSERTATION ABSTRACTS (MICROFILM ABSTRACTS prior to volume XII) may purchase the following issues, of which we have a small supply, at the standard price of \$1.50 each issue.

VOL.	ISSUE	VOL.	ISSUE
7	1	13	1
			2
8	2		3
10	3	15	6
	4		7
			8
11	1		9
	2		11
	3		12
	4		
12	1		
	2		
	3		
	4		
	5		
	6		

A microfilm copy can also be supplied of the first 10 volumes at a cost of \$46.60.

DISSERTATION ABSTRACTS is published monthly by University Microfilms, 313 North First Street, Ann Arbor, Michigan. Subscription rates are:
a. *Dissertation Abstracts* alone for 12 issues with no annual index: \$10.50 in the United States; \$11.50 foreign; b. a combined subscription to *Dissertation Abstracts* with the 13th index number, paper bound as the other issues: \$16.00; c. the *Index to American Doctoral Dissertations* alone, bound in hard covers: \$8.00.

TABLE OF CONTENTS

The Table of Contents lists in alphabetical order the principal subject headings of the dissertations abstracted. For the convenience of readers an alphabetical author index is included following the abstracts.

AGRICULTURE	1543
ANATOMY	1553
ANTHROPOLOGY	1556
BACTERIOLOGY	1557
BIOLOGY-GENETICS	1563
BOTANY	1566
CHEMISTRY	1570
ECONOMICS	1599
EDUCATION	1613
ENGINEERING	1645
FOOD TECHNOLOGY	1657
GEOGRAPHY	1657
GEOLOGY	1664
HEALTH SCIENCES	1666
HISTORY	1668
HOME ECONOMICS	1672
JOURNALISM	1673
LANGUAGE AND LITERATURE	1674
LIBRARY SCIENCE	1689
MATHEMATICS	1690
MUSIC	1696
PHARMACOLOGY	1697
PHILOSOPHY	1697
PHYSICS	1699

PHYSIOLOGY	1711
POLITICAL SCIENCE	1713
PSYCHOLOGY	1718
SOCIAL PSYCHOLOGY	1731
SOCIOLOGY	1732
SPEECH-THEATER	1735
ZOOLOGY	1740
AUTHOR INDEX	1747

AGRICULTURE

AGRICULTURE, GENERAL

A CONTRIBUTION TO THE STUDY OF SOILS BY MEANS OF ELECTRICAL RESISTIVITY APPARATUS

(Publication No. 18,267)

Nedavia Bethlahmy, Ph.D.
Cornell University, 1956

The Volusia-Mardin soil association, because of its poor drainage condition, constitutes a serious problem area in the southern New York plateau. An investigation was conducted to determine the applicability of the electrical resistivity method of geophysical exploration to a study of these soils. Data collected by the Wenner configuration, which consists of four equally spaced electrodes, and analyzed by superposition on standard curves yielded results pertaining to the depth of the substratum and the resistivity values of the several soil layers, and made possible the drawing of inferences with respect to subsurface flow of water.

Volusia and Mardin soil series have strongly expressed fragipans. If soil moisture conditions are such that the resulting resistivity curves can be interpreted by 2-layer standard curves, then the fragipan and overlying soil mass appear as one layer, while the substratum is the second layer. In such cases, the electrical resistivity method can be used only to determine the depth to the substratum. On the other hand, when soil moisture conditions are such as to require the use of 3-layer standard curves, then the fragipan is differentiated from the overlying soil, and the method may be used both for depth determinations and resistivity evaluations.

Depth determinations by 2 and 3-layer curve analyses may be combined. Depth to the substratum was determined to be greater in Mardin soils than in neighboring Volusia soils. Since the resistivity survey was combined with a topographic survey, conclusions could be drawn concerning the slope of the upper surface of the substratum. Similar slopes were found under Mardin and nearby Volusia soils. This led to the conclusion that the surface of Mardin soils is at a higher elevation than the surface of adjacent Volusia soils.

Resistivity analyses showed that the soil layers above the Volusia fragipan have a smaller resistivity value than their Mardin counterparts; that the fragipans of both soils have the same resistivity; and that the substrata of Mardin soils have resistivity values which are in some cases equal to, and at other times greater than the substrata resistivities of Volusia soils. These results led to inferences respecting the movement of water from one soil into the other. In wet periods, water flows horizontally over the fragipan from Mardin into Volusia soils. Some of the water flows downward through the permeable "gray streaks" in the Mardin fragipan until it reaches the substratum, where it again resumes a horizontal flow towards the Volusia substratum. Because the flowing water is confined between two impermeable strata, pressure may

be built up, forcing water upwards through the "gray streaks" in the Volusia fragipan. A piezometric study in Volusia soil sites confirmed the presence of water under hydraulic pressure underneath the fragipan.

191 pages. \$2.50. Mic 56-2407

AN APPRAISAL OF AND RECOMMENDATIONS FOR INCREASING THE DEGREE OF COMPETITION IN FLORIDA'S DAIRY INDUSTRY

(Publication No. 17,545)

Ernest Evan Brown, Ph.D.
The University of Florida, 1956

In Florida both administered and non-administered pricing of fluid milk has been used in arriving at producer and consumer prices. This lack of uniformity has been uniquely different from other states in the United States where only one type of pricing has been used. An unstable pricing situation exists in Florida due to the conflicting policies under which the Milk Commission operates. These conflicting policies have resulted in a patchwork system of pricing. These policies have led to non-regulation of producer blend prices and dealer marketing spreads.

The Commission's pricing regulations were found to be ignored by a large part of the Florida dairy industry. Eleven dealers out of 25 were found to be disregarding the use of established butterfat differentials as set up by the Commission. Forty out of 112 producers were not receiving butterfat differential payments. Ten dealers stated that their greatest marketing problem was the illegal discount practices being used in their markets.

When the Florida dairy industry was compared to a theoretical model of pure competition, none of the conditions of pure competition were met. By comparison, the dairy industry in other non-Florida regulated markets complied to some extent with four of the five requirements of pure competition. The dairy industry in Florida ranged from oligopsony-oligopoly to monopsony-oligopoly conditions. As a result of imperfect competition, a high degree of producer and consumer price inflexibility was found. Producer blend prices varied considerably, even when producers sold to the same dealer or to the same market.

Producers were dissatisfied with current utilization and butterfat payments, lack of alternative market possibilities, and lack of security in the market. In addition, existing producers had difficulty in shifting their sales from one outlet to another. New producers, who might be more efficient, were kept out of the dairy industry. The price and market structure restricted production and probably resulted in a higher cost of production and a higher cost to consumers for fluid milk. Agreements between existing producers and dealers restricted the entry of new producers into the market. In one market there has been total restriction of new producers for several years. In

order to develop a more competitive market under governmental regulation, either by the use of a State Milk Commission or by use of Federal Market Orders, consideration needs to be given to several factors. It is assumed that these factors would be considered if Federal Market Orders are used, hence the following suggestions deal only with regulation at the State level.

Among the suggested needs are: the establishment of economic marketing areas, pricing of all milk classes, establishment of market-wide pools, use of seasonal class price changes or use of a fall premium plan instead of the base-surplus plan, greater reliance on economic indicators and less dependence upon cost of production information in adjusting prices, institution of a wholesale milk price differential, a bonding law and restriction of dealer-producer credit practices. 314 pages. \$4.05. Mic 56-2408

ECONOMICS OF FIELD SHELLING AND ARTIFICIAL DRYING OF CORN IN ILLINOIS

(Publication No. 18,127)

Velmar Walk Davis, Ph.D.
University of Illinois, 1956

Field shelling, artificial drying, and farm storage of shelled corn was studied in Illinois on 77 farms during the 1954 harvesting season. Six additional farms were included on which high moisture corn was field shelled and stored in airtight bins. The complete harvesting process was studied from the viewpoint of integration into the farm business. Physical standards and standardized costs were determined for the total and all phases of the harvesting process.

Farms were located in central and northern Illinois; averaged about 400 tillable acres and 184 acres of corn; were about equally divided between grain and livestock farms; and included all systems of tenure. Field shellers were pull-type and self-propelled picker-shellers, and ear corn pickers with trailing shellers. Pull-type machines were the most numerous. Various makes and types of heating units were used but most were fuel oil direct-heat burners. About three-fourths of the drying structures were batch column type structures. New storage structures were nearly all circular steel bins and masonry silos.

Principal reasons farmers gave for making the shift to shelled corn methods were shortage of storage and cheaper shelled corn storage. Reduction of field losses and easier work were also important. The shift to shelled corn harvesting was incomplete on more than a third of the farms in 1954.

Differences were unimportant among types of field shellers with respect to field losses, quality of corn, and rate of harvesting. Reduction of field losses by earlier harvest and relatively low travel speed was one of the most significant economic effects in the use of field shellers.

Drying is the critical part of the whole harvesting operation from the standpoint of both management and costs. Heated-air drying is an entirely new operation involving complex technical relationships with which farmers are not familiar. Farmers were learning by experience fre-

quently at the expense of costly mistakes in underdried, overdried, or overheated corn. Drying costs are an addition to total harvesting costs and are influenced primarily by original cost of equipment, volume of use, and quantity of water removed per bushel.

Two-thirds of a group of 57 farmers reported storage difficulties with their 1954 corn involving crusting, spoilage, heating, and insect infestation. Most of the problem was the result of failure to store clean corn or to dry to low enough moisture content. Conditioning equipment may be necessary for farm storage of shelled corn.

Storage of high moisture corn in airtight bins as an alternative to drying has possibilities in terms of both lower costs and few management problems. This method is limited to the feeding of livestock, particularly beef cattle feeding operations on a fairly large scale.

The two-man crew is the most practical and efficient in the utilization of labor throughout the harvesting season. Field shelling, artificial drying, and storage of shelled corn should be integrated into the farm operation with respect to layout of drying and storage facilities, effect on feed processing and handling, feeding systems, and available labor.

The rate of adoption of shelled corn methods will continue to be gradual and will depend greatly on replacement needs for storage and mechanical pickers. Future improvements in the operational efficiency of heated-air driers and field shellers will reduce costs and make the shift more economically feasible.

Areas in which further research and extension work is needed:

- (1) design of field shellers to further reduce field losses and damage to kernels at high moisture content;
- (2) design of driers with controls to permit greater accuracy and speed in drying to specified moisture levels;
- (3) effect on feeding and milling qualities of corn field shelled and dried with heated-air at various levels of moisture content and drying temperatures;
- (4) potential effect of an increased volume of shelled corn marketed during harvest, both high moisture corn direct from the field and corn artificially dried;
- (5) appropriate cost sharing arrangements between tenants and landlords, custom rates of drying, and farm layouts of equipment and storage structures for typical farm organizations; and
- (6) work with farmers in integrating the shelled corn method into the farm operation including information on the frequent management difficulties inherent in the complete harvesting process.

209 pages. \$2.75. Mic 56-2409

AN ECONOMIC STUDY OF AGRARIAN
PROBLEMS IN INDOCHINA

(Publication No. 17,451)

Randall Stelly, Ph.D.
Louisiana State University, 1956

Supervisor: Professor Martin D. Woodin

This study analyzes economic conditions of Indochina as related to agrarian problems and indicates the nature of reforms necessary to improve the economic and social well-being of rural people. The study is based on available official and unofficial reports and on data developed by the author during four years as an agricultural economist in Indochina.

Indochina comprises the states of Cambodia, Laos and Vietnam, which in 1952, emerged as free nations after 75 years of French colonial administration. Indochina is largely agricultural and is faced with the serious agrarian problems characteristic of the Far East. About 90 percent of the 28 million inhabitants are engaged in farming, rice being the major crop. While agricultural products constitute nine tenths of the country's total production, less than one tenth of the land area is cultivated. Most farming is carried on in the deltas of the Mekong and Red rivers which support extremely large populations per square mile. In general, farms are small, living standards near the subsistence level, and most families heavily and continuously in debt. Nearly all agriculture is conducted by natives, although rubber, coffee, and some tea and rice plantations are French owned. Farming methods are primitive, yields relatively poor, and production per worker low. There is very little mechanical equipment and the use of draft animals is restricted because they compete with man for the limited food supply. Problems of land ownership and tenure relations include the large number of farmers on the available land, the parcelization of land holdings in North and Central Vietnam, and the share-cropper system, absentee landlords, insecurity of tenure and low percentage of farmer-owners in the south.

The need for agrarian reforms arises from the very unequal distribution of landholdings with a large percentage of the farm land in possession of a small percentage of the people, exorbitantly high land rental rates, usurious interest rates charged by moneylenders and merchants for loans, and the disorganized and unsystematic manner in which agricultural commodities are marketed. Ineffective government action in relieving these conditions results in social and political unrest.

Programs designed to improve the economic well-being of Indochinese peasants and, consequently, the national economy should emphasize increasing land productivity and farmer efficiency, and be accompanied by measures to assure equitable distribution of production. To fulfill these aims a reform program should:

1. Provide credit to farmers at reasonable interest rates to decrease farmers reliance on merchants and moneylenders.
2. Immediately effectuate reduction of land rent, establish greater security of tenure and formalize rights of squatters and displaced farmers on abandoned lands, and eventually redistribute lands more equitably.
3. Improve the agricultural marketing system by en-

couraging village farmer credit, marketing, and purchase cooperatives, reestablishing storage and basic processing facilities in rural areas, providing adequate market information, and revising taxation and credit policies.

4. Strengthen the government Agricultural Service to include a farmer education, information or agricultural extension section to acquaint farmers with possible benefits through improved crop production and harvesting.
5. Give greater emphasis to government rural education and health improvement programs.
6. Provide opportunities for more employment outside agriculture and reduce excess farm population.
7. Foster improvements in transportation, especially repairing war damage to facilities and building more farm-to-market roads.
8. Place greater emphasis on improving irrigation methods and water-control devices.

To implement such a program of agrarian reform will require the active participation of governmental organizations at national, provincial, and local levels. Government action to be effective must provide a greater opportunity for participation and self expression by the rural people for whom the program is designed to benefit.

466 pages. \$5.95. Mic 56-2410

MICROBIOLOGICAL MINERALIZATION AND
IMMOBILIZATION OF SOIL NITROGEN

(Publication No. 18,288)

Borislav Jovan Stojanovic, Ph.D.
Cornell University, 1956

Studies of the fixation of ammonium nitrogen were conducted with one Colorado soil and four New York State soils, Honeoye silt loam, Dunkirk silt loam, Ontario loam, and Mardin silt loam. The soils were compared as to their absorption capacity for ammonium ion supplied as the sulfate, nitrate, chloride, hydroxide and dibasic phosphate. The effect of two leaching solutions and the wetting and drying characteristics of these soils on the fixation process were also investigated.

These studies showed that New York soils fixed considerable amounts of ammonium ions when added at low rates and under wet conditions. Fixation appeared to be higher when soils were leached with Morgan's solution than if KCl-HCl were used. However, experiments using N^{15} -labeled ammonium indicated that Morgan's solution was the more efficient for NH_4^+ -N recovery.

When the soils were heated at $95^\circ C$ for 10 hours the highest fixation of ammonium nitrogen was observed in the Colorado soil. Fixation data obtained in tracer experiments showed that about 10-30 per cent more ammonium nitrogen was fixed by heated soils than by either moist or air-dried samples. When the soils were air-dried after the addition of the ammonium nitrogen, fixation was higher than in the wet soils but was less than in samples heated at $95^\circ C$. In the dry soil, sodium was more efficient in replacing fixed ammonium than was potassium. Recoveries of N^{15} nitrogen were lower in these studies than the corresponding total recoveries using N^{14} nitrogen. This

suggests that the fixed ammonium may be in equilibrium with other forms so that some is released while added ammonium is fixed.

Laboratory studies using a perfusion technique were carried out with Honeoye silt loam under controlled temperature, moisture, aeration and pH. It was shown that high concentration of ammonium nitrogen applied as ammonium sulfate under alkaline conditions is a potent inhibitor to the *Nitrobacter* group of soil bacteria. Nitrite derived from the microbiological oxidation of the ammonium accumulated and persisted for extended periods. For example, when ammonium nitrogen was applied at the rate of 500 µg. per ml. of perfusing solution, only 2 µg. of ammonium and 1 µg. of nitrite nitrogen were present per ml. of percolating liquid at the twentieth day of incubation. Using an application of 1,778 µg. ammonium nitrogen per ml., 515 µg. of ammonium and 826 µg. of nitrite nitrogen per ml. were detected on the twentieth day. At the same time, only 266 µg. of nitrate were formed by the oxidation of ammonia. If comparable high levels of nitrite are added, however, all of the nitrogen was oxidized to nitrate within 12 days. The accumulation of nitrite formed from ammonium nitrogen apparently results from a specific, toxic effect of ammonium nitrogen to the nitrite oxidizing bacteria of the soil.

The effect of low temperatures on the nitrogen transformations in Honeoye silt loam was studied at 5° and 10°C. Soil samples were incubated for six weeks at constant temperature, moisture and aeration with and without additions of inorganic nitrogen, plant residues, or a combination of the two. These investigations have demonstrated that: (a) mineralization of organic nitrogen is of significant magnitude at 5°C; (b) ammonification seems to predominate at both 5° and 10°C; (c) nitrate formation occurs at temperatures as low as 5°C; (d) immobilization of mineral nitrogen took place when low nitrogen plant residues were present in soil even as low as 5°C; (e) nitrogen-rich plant residues permitted a higher rate of mineralization with a consequent greater nitrate formation.

102 pages. \$1.50. Mic 56-2411

AN ECONOMIC ANALYSIS OF THE ORGANIZATION AND OPERATION OF A SAMPLE OF SOUTHERN ILLINOIS FARMS WHICH MAINTAIN BEEF COW HERDS

(Publication No. 18,213)

Harvey Smith Woods, Ph.D.
University of Illinois, 1956

The supply of productive land and available capital is limited in southern Illinois. Capital and labor are frequently used inefficiently. The purpose of this study was to determine if and under what conditions a beef cow herd can be profitably included in farm businesses of the area.

Records and practices on 66 farms in the unglaciated southernmost counties were studied; all 66 farmers maintained beef cow herds. The farms were sorted for study and analysis on the basis of (1) annual inputs and (2) number of acres.

In all groups of farms, land, cattle, buildings, and machinery and equipment made up 88 to 91 per cent of the

total investment. As size of business increased, variable costs became proportionally a larger part of total costs. Cattle, hogs, crops, and products used in the household accounted for over 90 per cent of the total farm returns. Returns in 1954, partially as a result of drouth conditions, were not adequate to pay cash expenses, labor costs, interest on investment and depreciation. Consequently, all groups of farms had negative management returns.

Improved soil management practices (particularly soil fertility) offer one of the greatest opportunities for increasing farm income in the area. Improved pastures would support larger herds and thereby increase production efficiency. Livestock management practices such as the use of higher quality breeding animals, controlled breeding seasons, more care and attention during the calving season to assure a 90 to 95 per cent calf crop, and timely dehorning, castration, and vaccination would also increase returns.

Three different budgets were prepared and analyzed for part-time, low-input, and high-input farms. First, an analysis was made of the present program. Second, soil management practices were improved to near optimum, sufficient brood cows to utilize the increased amounts of roughage produced were added and surplus grain was sold. Third, the program was the same as the second except the swine enterprise was expanded to use all corn produced. In all cases the second alternative provided more favorable economic results than the first, and the third more favorable than the second. With the currently available farm acreage and labor supply, both the second and third alternatives provided for larger cow herds than the first. The increased earnings shown by the two new systems were the result of a more favorable price-cost relationship, more efficient production and a larger volume of business.

Beef cow herds have a place in southern Illinois. However, as a result of interregional competition, the following conditions must be met: a large acreage of low price land used effectively to produce roughage, a long grazing season, and a large herd of cows managed efficiently. In many cases, the beef cow herd should be secondary to other enterprises that will use resources more effectively.

Suggestions and proposals for increasing farm income in the area:

1. Increase the productive capacity of soil resources to near optimum through the development of sound soil fertility programs.
2. Adopt presently recommended soil erosion control measures needed and include as much grain as possible in the cropping system even though this may necessitate complete revision of the present field arrangement, cultural methods, and cropping system.
3. Produce hay and pasture crops on land where the topography is not suited for frequent cultivation.
4. Combine the agricultural resources available into a farm business with a scale of operation which has the potential to provide, under normal production conditions, the needs for the farm family.
5. Employ the fixed labor on the farm productively in livestock enterprises which utilize the grain and roughage crops produced or on other labor intensive crop enterprises such as small fruits and vegetables.
6. Be aware of the advantages and disadvantages of beef cow herds, that beef cattle are not the only roughage consuming animals, and that if a reasonable percentage of

the total agricultural population of the area is to have opportunity for productive employment, other livestock may have to be used instead of, or in conjunction with, the beef cow herd. 273 pages. \$3.55. Mic 56-2412

AGRICULTURE, ANIMAL CULTURE

EFFECTS OF CERTAIN STEROID HORMONES ON GROWTH AND FEED EFFICIENCY IN CHICKENS

(Publication No. 18,130)

Richard Channon Eaton, Ph.D.
University of Illinois, 1956

It is a well-known fact that male chicks grow faster than do female chicks. The reason for this difference remains unknown although it is reasonable to assume that this growth differential may be caused by sex hormones. The hypothesis that androgenic compounds influence rate of gain, feed consumption and feed utilization in growing chickens was investigated. The effect of estrogen on the pituitary and its hormones was also studied. In another phase androgen and estrogen were given in separate implants to each chick to determine whether the anabolic effect of androgen on protein metabolism (resulting in somatic gain), and estrogen effects on lipogenesis and additional feed consumption, can be combined to cause a more rapid rate of gain.

These data show that single or multiple implants of androgen between the levels of 1- and 16-mg. were ineffective as a growth stimulator in young chickens. At the 16-mg. level androgen caused some inhibition of growth rate in both sexes.

Untreated birds consuming a 14 percent protein ration grew more slowly than did those on a 23 percent diet, the latter level being in the range recommended by the National Research Council. Chickens receiving 14 percent protein and 15- or 20-mg. of estrogen grew more rapidly than did untreated birds on a 23 percent protein ration and just as rapidly as those receiving similar hormone treatments on a diet of 23 percent protein. It appears that birds treated with estrogen receiving 14 percent protein were meeting their protein requirement by increased feed consumption, and that protein levels in excess of 14-17 percent were being utilized inefficiently. In males fed (0.25-4 mg./day) estrogen, rate of gain decreased, while feed consumption remained constant.

Hypophysectomized birds implanted with estrogen failed to show increased feed consumption, whereas implanted intact males increased their feed consumption by 30 percent. Furthermore, in estrogen-implanted hypophysectomized males there was no increase in fecal and urinary nitrogen excretion as there was in normal males treated with 20-mg. of diethylstilbestrol. In none of these experiments was there any evidence for an anabolic effect of estrogen.

Estrogen-androgen combinations temporarily produced increased rate of gain which were largely due to estrogen and lasted only during the first week of treatment, while during the second week estrogenic effects were suppressed to an extent which depended on the level of androgen. The

causes of this antagonism remain unknown. In capons simultaneous administration of estrogen and androgen produced a synergistic growth response.

Because androgen and estrogen are known to have anabolic effects in other animals it became of interest to study the relationship of these hormones to protein metabolism in the chick. Nitrogen balances were made with individual chicks to investigate these effects.

In five experiments in which nitrogen balances were determined, chicks were injected with androgen (dosage varied from 0.5-mg. to 1.0-mg. for 7 days), estrogen (15- and 20-mg implants), mammalian growth hormone (0.25- to 4.00-mg. daily for 7 days), or thyrotrophic hormone (0.5- to 8-mgs. daily for 7 days). In some experiments nitrogen retention was compared in normal and hypophysectomized chicks.

Growth hormone, thyrotrophic hormone or androgen caused no significant changes in nitrogen retention or in growth rate of normal males; and androgen and estrogen were without effect in hypophysectomized males. Estrogen caused a significant increase in nitrogen excretion in intact males. Failure of growth hormone or androgen to cause an increase in nitrogen retention is in contrast to the effectiveness of these hormones in mammals.

79 pages. \$1.50. Mic 56-2413

A STUDY OF SOME EFFECTS OF PELLETING A GROUND MIXED RATION ON FEED UTILIZATION BY GROWING-FATTENING LAMBS

(Publication No. 18,131)

Alma Lamar Esplin, Ph.D.
University of Illinois, 1956

The first feed pelleting machine was introduced into the United States in 1929. Since that time there has been an increasing interest in the feeding of pelleted feed to livestock. It has been estimated that one-third of all manufactured feed was pelleted in 1955 and that 65 percent of all pelleted feed was fed to poultry. Some of the advantages claimed for pelleting of feeds are: (1) reduced wind loss, (2) reduced dust, (3) reduced billing or nosing out of feed, (4) each bite the complete ration as fed, (5) less crowding, (6) saving of labor in handling of feed, (7) increased feed intake, (8) increased gains when self-fed, (9) improved carcass grade, (10) improved palatability, (11) less feed refused in the manger and (12) reduced storage space.

The literature available on pelleting of feeds is scattered and is not plentiful. The literature was reviewed and some of it presented in tabular form. Included in the review are the feedlot data for each class of livestock and the pelleting process.

Three feedlot tests were conducted with lambs using individual and group feeding to compare the relative value of a ration consisting of 47.5 percent ground corn, 47.5 percent ground alfalfa hay and 5 percent molasses fed in the pelleted and unpelleted forms. Four digestion trials and two nitrogen retention trials were conducted comparing the pelleted and unpelleted feed when fed to lambs. A palatability test was conducted using the pelleted and unpelleted feeds. Rumen contents from lambs fed pelleted feed and from lambs fed unpelleted feed were examined.

The weights of a bushel of pelleted and of unpelleted feed were determined.

The pelleting of a ground mixed ration increased the palatability. When group self-fed, lambs ate more pelleted feed with significantly larger gains but with only a little less feed required to produce a pound of gain than lambs self-fed the unpelleted mixed ration. When lambs were individually fed the same amount of pelleted feed as other lambs were individually fed unpelleted feed, the gains and the amount of feed needed to produce a pound of gain were the same for both forms of the ration. In all cases the lambs fed pelleted feed had slightly higher dressing percentages and had higher average carcass grade than the lambs fed the unpelleted feed.

There were no significant differences in apparent digestibility for dry matter, nitrogen free extract, ether extract or crude fiber between the pelleted and the unpelleted rations. The apparent digestibility of nitrogen in the unpelleted ration was significantly higher in digestibility at the 0.05 level of probability than in the pelleted ration. There was no significant difference in nitrogen retention between the pelleted and the unpelleted feed when fed the same amount of feed.

Four times as much pelleted feed was eaten as unpelleted feed when ten lambs had free choice of the two feeds for two weeks.

There were no apparent visual differences in the rumen contents from lambs fed pelleted feed and from lambs fed unpelleted feed.

A bushel of pelleted feed weighed 45.45 percent more than a bushel of the unpelleted feed.

These investigations indicate that pelleting a mixed ground ration for lambs increased palatability thereby increasing consumption and rate of gain with improvement of carcass grade. Pelleting apparently does not materially influence the nutritive value of a mixed ground ration.

111 pages. \$1.50. Mic 56-2414

THE EFFECT OF CHLORTETRACYCLINE (AUREOMYCIN) ON THE PANTOTHENIC ACID REQUIREMENTS OF WEANLING PIGS

(Publication No. 17,554)

John Ignatius McKigney, Ph.D.
The University of Florida, 1956

Four experiments, using a total of 160 weanling pigs in drylot, were conducted to determine: (A) whether low-protein corn-soybean oil meal rations tend to be more limiting in niacin, pantothenic acid or riboflavin; (B) possible interrelationships between pantothenic acid, vitamin B₁₂ and chlortetracycline in rations of this type; (C) if chlortetracycline has a sparing action on the dietary pantothenic acid requirements of weanling pigs under the conditions imposed; (D) the effect of supplementing such rations with pantothenic acid or chlortetracycline on the level of pantothenic acid in various organs; and (E) the effect of the ration differences on cytochrome oxidase activity of the heart left ventricle and right central lobe of the liver.

In all experiments, the corn-solvent soybean oil meal rations were calculated to contain 14 percent crude protein. All rations were supplemented with vitamins A and

D. In the first two experiments, all B vitamins, with the exception of those being tested, were added to bring the ration levels to or above the levels recommended by the National Research Council for 25-pound pigs.

The results of the first experiment indicated that pantothenic acid is more limiting in rations of this type than niacin or riboflavin. The content of this vitamin in the rations tested appeared to be approaching the borderline level for 37-38 pound weanling pigs which had received good forage while with their dams.

It was indicated in the second trial that 20-27 pound weanling pigs had a higher dietary requirement of pantothenic acid than those used in the previous experiment. Both groups of animals had similar nutritional histories before weaning. Supplementation of the rations with vitamin B₁₂ stimulated growth of the animals but this vitamin appeared to have no sparing action on the dietary pantothenic acid requirements of the pigs under the conditions imposed. Supplementation of the rations with chlortetracycline, whether alone, or in the presence of supplementary pantothenic acid or vitamin B₁₂, improved performance of the pigs. This antibiotic appeared to spare the dietary requirements of the pigs for pantothenic acid.

In experiments three and four, similar rations fortified with vitamins A and D, and all B vitamins except pantothenic acid were used. The experimental groups of animals received this ration as such, or supplemented with 6.2 milligrams of pantothenic acid or 10 milligrams of chlortetracycline per pound. Pigs which were weaned at 5 weeks of age were used in these trials.

In both experiments, pantothenic acid deficiency symptoms developed in many of the pigs receiving the unsupplemented ration. Supplementation with either pantothenic acid or chlortetracycline prevented these symptoms, indicating a sparing action by the antibiotic on the dietary pantothenic acid requirements of the animals. Chlortetracycline supplementation increased average daily gains and feed consumption to a greater extent than did pantothenic acid supplementation.

Pantothenic acid or chlortetracycline supplementation produced no consistent effect on the level of pantothenic acid in the adrenal glands, brain cerebrum or heart left ventricle of the animals. Supplementation with the antibiotic resulted in a significant increase in the level of pantothenic acid in the right central lobe of the liver and a significant decrease in the level of this vitamin in the kidney cortex. Pantothenic acid supplementation resulted in an increased level of pantothenic acid in the liver and a decreased level in the kidney, but not to a significant degree.

Differences in ration treatment apparently had no effect on the cytochrome oxidase activity of the heart left ventricle or right central lobe of the liver in these animals.

147 pages. \$1.95. Mic 56-2415

AGRICULTURE, FORESTRY AND WILDLIFE
THE USE OF AERIAL PHOTOGRAPHS IN CRUISING
SECOND-GROWTH DOUGLAS-FIR STANDS

(Publication No. 17,123)

John Richard Dilworth, Ph.D.
University of Washington, 1956

The vertical aerial photograph has become an important tool to the forester for use in many phases of his professional work. The purpose of the present study was to investigate the feasibility of cruising forest stands directly from aerial photographs.

Most of the basic data were collected on ninety 1/5-acre plots located at random in the second-growth Douglas-fir (*Pseudotsuga menziesii* Mirb.) stands of the McDonald Forest in the Willamette Valley of Oregon. A total of 320 sample tree measurements collected in northwestern Oregon were also used.

All tree and stand measurements needed to determine tree volume, stand density, and site quality were taken on these plots. The average visible crown diameter (V.C.D.) of each dominant and codominant tree was also measured.

The relationship between visible crown diameter and diameter at breast height (V.C.D.-D.B.H.) was determined for these data. The regression lines representing this relationship were rectilinear in each case and showed a standard error of estimate ranging from 1.17 to 2.53 inches. The correlation coefficients varied from +0.900 to +0.996. The influence of tree height, site quality, stand density, and geographical location on this relationship is as follows:

1. The addition of tree height as a second independent variable increases the accuracy with which D.B.H. can be estimated.

2. A suitable equation for estimating D.B.H. (Y) from V.C.D. (X_2) and total height (X_1) by the multiple regression method is:

$$Y = b_0 + b_1X_1 + b_2X_2 + b_3X_1X_2$$

When: b_0 = intercept

b_1, b_2, b_3 = regression coefficients

3. As the site quality decreases, the V.C.D. increases for a given D.B.H.

4. Increases in stand density above seventy per cent do not have any appreciable influence on the V.C.D.-D.B.H. relationship. In medium and poorly stocked stands, as the density decreases, the V.C.D. increases for a given D.B.H.

5. Geographical location appears to have a limited influence on the V.C.D.-D.B.H. relationship.

Local and standard photo-volume tables were derived from Tables 12 and 14 in U. S. D. A. Technical Bulletin 201. A test of precision of the local tables showed an aggregate difference of -1.4 per cent and a standard error of estimate of 26.7. A similar test of the standard tables gave aggregate differences varying between +0.41 and -0.78 per cent and standard errors of estimate ranging between 6.9 and 13.5 per cent.

A photo-cruise of seventy of the field plots using the local photo-volume tables gave volumes having an aggregate difference of -3.0 per cent and a standard error of estimate of 19.0 per cent. The field plot volumes were plotted over the photo-cruise plot volumes and a regression line was drawn. When the photo-volumes were re-computed for each plot using this new regression line, the

aggregate difference was reduced to -1.2 per cent and the standard error of estimate was lowered to 14.4 per cent.

A photo-cruise of the seventy plots using a standard photo-volume table gave an aggregate difference of -2.8 per cent and a standard error of 13.4 per cent. These results do not include any correction for the volume in trees not visible on the aerial photographs. The correction for these plots is +3.6 per cent.

The average stem count per photo plot had an average difference of +1.0 \pm 2.02 trees from the field plot. A comparison of the average V.C.D. per plot as determined by field and photo-measurements showed the estimates on the photographs to have an average deviation of -0.5 \pm 1.84 feet.

The present study has indicated that cruising second-growth Douglas-fir stands directly from aerial photographs is possible at the normal standards of accuracy.

168 pages. \$2.20. Mic 56-2416

AGRICULTURE, PLANT CULTURE

THE ROLE OF AMINO ACIDS AND CERTAIN OTHER
METABOLIC AGENTS ON THE TOXICITY OF
COPPER SULFATE TO SPORES OF STEMPHYLIUM
SARCINAEFORME (CAV.) WILTS AND MONILINIA
FRUCTICOLA (WINTER) HONEY

(Publication No. 18,109)

Angelos Vasilios Adam, Ph.D.
University of Illinois, 1956

This study constitutes mainly an attempt to determine the behavior of different concentrations of copper sulfate under the influence of a wide variety of metabolic agents as manifested in terms of toxicity to spores of *Monilinia fructicola* and *Stemphylium sarcinaeforme*. However, in order to more critically and accurately interpret the results of such a study it was felt necessary to first conduct a number of experiments designed to elucidate certain phases of copper sulfate toxicity. An attempt was also made to study the nature of spore excretion products through the use of chromatography.

It was discovered that water soluble nutrient components of culture media exhibit a detoxification effect on copper sulfate toxicity. *S. sarcinaeforme* spores proved more effective in detoxifying a 10 ml, 16 ppm copper sulfate solution than *M. fructicola* spores. A ten minute contact period was required for approximately 12⁵ spores of *M. fructicola* to absorb a lethal dose of copper from the above-mentioned solution as compared to fifty minutes for *S. sarcinaeforme*. Spores of both test fungi, separately, absorbed copper at a faster rate during the first three minutes of contact. Short periods of exposure of spores to a 16 ppm copper sulfate solution induced a decrease in lag period and an increase in the final germ-tube size. Fungitoxicity among metabolic agents was rather common but most of the non-toxic agents exhibited a stimulatory effect on spore germination. Copper sulfate was shown to have its toxic action reversed by a large number of metabolic agents, the amino acid group being the most effective. The toxicity of copper sulfate was shown in the majority

of cases to be roughly, but not accurately, an inverse function of the concentration of the metabolite. Restoration of germination to spores which had earlier received a toxic dose of copper was obtained by exposing them to a non-toxic solution of the reversing metabolite. It proved impossible to restore germination to spores of *M. fructicola* which had been previously treated with a 16 ppm copper sulfate solution for a period of two hours or longer. *S. sarcinaeforme* spores acted similarly after three hours of exposure or longer. It was shown that the detoxification process can take place inside the spore wall.

Spore excretion products also exhibited a detoxification effect on copper sulfate toxicity. *S. sarcinaeforme* spores showed a greater potentiality towards detoxification than spores of *M. fructicola*. The highest detoxification rate was obtained from spores incubated for ten to twenty-four hours. Five different, physiologically active, compounds were shown chromatographically to be present in extracts of germinating spores of *S. sarcinaeforme* as compared to three in the case of *M. fructicola* spores. Peak of excretion of these products was reached after thirty-six hours and forty-eight hours for *S. sarcinaeforme* spores and *M. fructicola* spores, respectively. Beginning of excretion occurred after four hours and ten hours of incubation for *S. sarcinaeforme* and *M. fructicola*, respectively. In the case of both fungi the spots on the chromatograms indicating the presence of metabolic substances disappeared after one hundred and fifty-six hours of spore incubation.

110 pages. \$1.50. Mic 56-2417

INOCULATION, LIFE CYCLE AND HOST-PARASITE RELATIONSHIP OF SEPTORIA TRITICI ROB. ON TRITICUM SPECIES

(Publication No. 18,150)

Halim Massoud Hilu, Ph.D.
University of Illinois, 1956

Speckled leaf blotch, caused by *Septoria tritici* Rob., is world wide in distribution and is becoming of importance in many localities. Of the many methods tried, a piece of absorbent cotton was found suitable for the inoculation of a small number of plants. After inoculation the plants required a period of 3-4 days in a moist chamber. Water-soaking the leaves with a dilute spore suspension by means of a pressurized atomizer or syringe supplied with a one-hole rubber stopper, is recommended as a technique for inoculating large numbers of plants. Satisfactory infections were obtained by the water-soaking method without the use of a moist chamber. Injecting the inoculum inside the culm with a hypodermic needle can only be used on young seedlings. The results of many root rot tests revealed that the pathogen infects only the above-ground parts.

The incubation period was about 9 days but ranged from 7 to 16 days and was longer at lower temperatures. In general the symptoms appeared first as minute light green chlorotic spots which became rapidly necrotic, enlarged and turned yellow to light brown in color. In younger plants the lesions were oval but in older plants they enlarged lineally between the veins. In either case, however, dark brown pycnidia developed beneath both surfaces of the dead tissues.

The effects of field conditions, different temperatures, and freezing and thawing on the longevity of the primary inoculum, were determined. The fungus overwinters as pycnidia in volunteer wheat plants or in the leaves and leaf sheaths lying on the surface of the soil. The spores in the pycnidia incite the disease early in the fall and secondary cycles are repeated as long as favorable environment prevails. In the winter, the pathogen ceases to grow, but remains viable in the infected plants. In the early spring the primary inoculum, consisting of spores borne in pycnidia or a continuation of a secondary fall cycle, initiates the disease. Many secondary cycles follow and spread the disease during the season. During or prior to harvest, infected leaves and leaf sheaths fall to the soil and the fungus completes its cycle.

Under greenhouse conditions, all varieties of *T. vulgare* were susceptible, whereas, varieties of *T. durum* varied in their reaction from susceptible to intermediate and resistant. Resistance was expressed as a lower percentage of leaf infection and a smaller number of lesions. The pathological histology was studied in detail using C. I. 12557 (susceptible), Kubanka (intermediate), and Arnautka (resistant) wheat seedlings. The fungus usually penetrated either the opened or closed stomata and direct penetration was observed only occasionally. Without exception, the hyphae grew intercellularly in all directions, branched irregularly, and were limited only by the bundle sheaths. In the later stages, most mesophyll cells were completely surrounded by the hyphae, died and became separated. Subepidermal pycnidia, of the symphogenous type, developed in the substomatal chambers, and were larger in the susceptible than in the intermediate or resistant varieties. The host-parasite relationship was essentially the same in the 3 varieties. The fungus penetrated the leaves of the 3 varieties, but in most cases failed to develop in the resistant and intermediate varieties. In addition, the hyphae in the leaves of these 2 varieties grew slower resulting in a longer period of incubation.

A number of cereals and other grasses were inoculated in the greenhouse to determine the host range. Infection was obtained on species of *Triticum* only.

Necrotic lesions, similar to those produced by the pathogen, developed when the culture filtrate of the fungus was driven inside the leaf. The time required for the appearance of these lesions corresponded to the incubation period of the fungus.

107 pages. \$1.50. Mic 56-2418

THE EFFECTS OF CERTAIN ENVIRONMENTAL FACTORS ON SEED PRODUCTION IN SIDE-OATS GRAMA

(Publication No. 17,361)

Ernest Baker Jackson, Ph.D.
The University of Nebraska, 1956

Adviser: Franklin David Keim

The effects of several factors on seed production in Nebraska 37 and Nebraska 52 side-oats grama, *Bouteloua curtipendula* (Michx.) Torr., were studied at the Nebraska Experiment Station, during the three years 1952 to 1954. Experiments were conducted in the greenhouse and in field plots on the Agronomy Farm.

In order to compare the effects of various cultural practices on the yield of viable seed, a direct test of seed quality was modified so that it could be used on side-oats grama. Seed yields were determined in pounds of whole spikes per acre and then adjusted to a uniform quality basis of 150,000 viable seeds per pound.

The field experiment extended over the three-year period and included four rates of application of nitrogen with and without phosphorus fertilization in conjunction with burning and non-burning treatments. The results showed that spring burning as a means of clearing the field of old growth had no detrimental effects on seed yield. Nitrogen proved to be the important fertilizer element in producing increased yields of side-oats grama seed. Even under drought conditions, 30 pounds of nitrogen per acre increased the yield of seed. Sixty and 90 pounds of nitrogen per acre failed to produce significant increases in seed yield above that from the 30-pound rate.

In the greenhouse, percentage seed-set in florets classified according to the number of pollen grains observed on their stigmas indicated a direct relationship between amount of pollen and fertilization of the ovary. Where the stigmas received fewer than 10 pollen grains 7 to 8 per cent of the florets produced caryopses as compared with approximately 15 per cent seed-set in florets receiving large numbers of pollen grains. In another study only 14 per cent of the florets examined approximately 15 hours after hand pollination were found to have germinated pollen adhering to the stigmas.

Inflorescences of side-oats grama were treated with auxins at the time the first spikes began blooming. Treatments consisted of 1 and 10 ppm. indolebutyric acid, 1 ppm. indoleacetic acid, and 10 ppm. alpha-naphthaleneacetamide all applied as aqueous sprays; and one per cent alpha-naphthaleneacetamide in lanolin brushed along the rachis of each spike. Of these, none significantly increased seed-set. All but the 10 ppm. indolebutyric acid spray resulted in seed-set percentages lower than those for the comparable checks.

Both seed-set and yield of spikes were determined for plants grown under different environments in the greenhouse. The results were yields of 272 and 333 spikes per plant grown at low and high soil moisture, respectively, in an atmosphere of high humidity and relatively low temperature as compared with 372 and 461 spikes per plant for the same moisture levels in an atmosphere of relatively low humidity and high temperature. The effects on seed-set of these environments were similar, except that there was some blasting of spikes when soil moisture dropped to the point where the grass wilted during periods of high temperature. These findings are supported by the results of an irrigation test in the field in 1954. Although the weather was dry and hot during the blooming and fruiting period of the Nebraska 37 strain, excellent seed yields were obtained from plots with favorable soil moisture as compared with poor yields from non-irrigated plots.

99 pages. \$1.50. Mic 56-2419

COMPETITION BETWEEN LEGUME AND GRASS VARIETIES IN PERENNIAL FORAGE MIXTURES

(Publication No. 18,301)

Wiley Carroll Johnson, Jr., Ph.D.
Cornell University, 1956

Chairman: C. C. Lowe

This study was undertaken with the objectives of determining: (1) the extent of variation in competitive ability between varieties of widely different types within several commonly used forage species; (2) the time of occurrence of any differential loss in stand of legume varieties within mixtures; (3) the effect this had on the forage production of mixtures; and (4) the precise competitive relationships which existed between the legume and grass varieties studied.

Tests were planted at two locations in 1954. Thirty-five mixtures consisting of four varieties of alfalfa and three trefoil varieties were grown alone and in association with each of three bromegrass varieties and common timothy. Four successive counts of legume population densities in each association were made during 1954-1955. Yield measurements were obtained from two hay harvests at each location in 1955. Botanical composition of the forage was estimated prior to each harvest.

A nearly identical test was planted in 1955. Two counts of legume population density were made in the seedling year.

Data obtained from these tests were analyzed to evaluate competitive relationships and their influence on yield in the first year of harvest.

Counts of legume plants in the various associations during the seedling year revealed that population density was markedly influenced by environmental conditions, but wide difference existed between legume species and between varieties within species for competitive ability as seedlings. The competitive abilities of the legume varieties were consistent for the years and locations included in the study. Ranger alfalfa was less competitive than the other alfalfa varieties (Du Puits, Narragansett, and Vernal), and Empire trefoil was less competitive than either European or Viking.

Legume plant counts further revealed that the population densities of all varieties at six weeks after seeding were reduced by approximately 50% by the end of the first harvest year.

Grass varieties were somewhat slower in establishment than the legumes with which they were grown. For this reason, no effect on the legumes by differential aggressiveness of the grass varieties were detected until the first harvest year. At this time, data on yield, forage composition, and legume population density revealed marked differences between the aggressiveness of the grass varieties and also differential competitive responses of the legume species and varieties. The order of aggressiveness of grass varieties was found to be Saratoga bromegrass, Northern bromegrass, Lincoln bromegrass, and timothy (timothy being the least aggressive).

The aggressiveness of grasses is expressed by the suppression of legume plants which can eventually result in the elimination of these plants. Therefore, it was found necessary to consider both plant vigor, as indicated by forage composition, and population density in order to

evaluate competitive relationships at any given time in the life of the stand.

The variation found within forage species with regard to competitive characteristics and its influence on production indicates that these characteristics should be considered in evaluations of forage varieties in order that the most compatible and productive mixtures may be obtained.

98 pages. \$1.50. Mic 56-2420

THE UPTAKE OF IONS BY EXCISED BARLEY ROOTS FROM SOIL-WATER SYSTEMS

(Publication No. 18,303)

John Vincent Lagerwerff, Ph.D.
Cornell University, 1956

This study was concerned with the characterization of the ionic environment of the plant root in soil-water systems. Excised, low-salt barley roots were exposed to rubidium-saturated montmorillonite suspensions and their equilibrium dialyzates. Although the concentration of Rb^+ in the suspension was many times higher than that in the dialyzate, the uptake of Rb^+ by the roots was the same, indicating that ion uptake is not a function of ion activity or ion concentration in the substrate. In equilibrium soil-water systems, therefore, the suspension effect has no physiological significance inasmuch as the soil solution, equilibrated with the soil, should completely characterize the ionic environment of the plant root.

A study was then undertaken of the different mathematical formulations of ion exchange equilibria in soils. Dialysis experiments were carried out with saturated and unsaturated suspensions of montmorillonite and illite, to which Ca^{++} and K^+ were the only ions added. The data were used to calculate the exchange constant k in Gapon's equation

$$\frac{\gamma_{K^+}}{\gamma_{Ca^{++}}} = k \frac{C_{K^+}}{\sqrt{C_{Ca^{++}}}} .$$

A comparison of the values of k thus obtained with those calculated according to the Gouy-Chapman double-layer theory as formulated by Eriksson showed a good agreement for montmorillonite suspensions and a very poor agreement for illite suspensions. This was considered to indicate that in montmorillonite suspensions the distribution of K^+ and Ca^{++} is determined by Coulomb-type forces, whereas in illite suspensions specific adsorption forces for K^+ must be dominant. The value of Gapon's exchange constant proved not to be a constant but depended on the nature and the relative proportions of the cations adsorbed as well as on the total salt concentration.

A study was undertaken of the initial phase of the process of ion uptake. It was recognized that cations and anions must be independently adsorbed before they can be accumulated by the root. Consequently, it was proposed that the uptake (u) of ions (M) will reflect the ionic composition of the root surface (sr) rather than that of the nutrient medium, according to the relationship

$$\frac{dM_u}{dt} = k M_{sr} ,$$

where k is the specific rate-of-uptake constant the magnitude of which is determined by all metabolic factors known to influence the accumulation of ions.

Finally, a study was undertaken to determine the parameter that would best describe the ionic composition of the root surface and ion uptake. It was recognized that the surface charge density and surface potential of the root determine the ionic relationship between the soil solution and the root surface. From the uptake of Rb^+ and Ca^{++} from solutions of $RbCl$ and $CaCl_2$ in which the concentrations were increased in a constant reduced ratio

$$\frac{a_{Rb_0^+}}{\sqrt{a_{Ca_0^{++}}}} ,$$

it was shown that under these conditions the electric behavior of the roots could be best associated with a constant root surface charge density. From theoretical considerations it then follows that preference should be given to the reduced ratio between the concentrations of any pair of ions rather than to their absolute concentrations for assessing the nutrient status of the soil solution.

From a comparison of the uptake of Rb^{++} and Ca^{++} from solutions of $RbCl$ and $CaCl_2$ in which the concentrations were increased with and without maintaining a constant ratio

$$\frac{a_{Rb_0^+}}{\sqrt{a_{Ca_0^{++}}}} ,$$

it was concluded that the uptake of Rb^+ or Ca^{++} distinctly reflects a change in the concentrations of the ion species in solution only if this change is associated with a change of the ratio

$$\frac{a_{Rb_0^+}}{\sqrt{a_{Ca_0^{++}}}} .$$

This evidence confirms, on basis of the consideration that

$$a_{Rb_0^+} / \sqrt{a_{Ca_0^{++}}} = a_{Rb_{sr}^+} / \sqrt{a_{Ca_{sr}^{++}}} ,$$

that the roots respond to changes in the ionic composition of the root surface rather than to changes in the ionic composition of the soil solution.

99 pages. \$1.50. Mic 56-2421

EVAPO-TRANSPIRATION RATES FOR VEGETABLE CROPS IN NEW YORK STATE AND SOME RELATIONSHIPS WITH CLIMATOLOGICAL DATA

(Publication No. 18,283)

Nathan Hiram Peck, Ph.D.
Cornell University, 1956

Evapo-transpiration rates for irrigated peas, alfalfa, tomatoes, cabbage and sweet corn were determined for the growing seasons of 1952-1955, and some relationships with weather data examined.

These studies were part of an experiment on supplemental irrigation for vegetable crops at Geneva, New York.

The soils have been classified as predominately Kendaia and Lima silt loams and were recently tile drained.

Available water storage capacities of the 0-8 inch, 8-16 inch and 16-24 inch depths of surface soil were estimated from bulk density, moisture equivalent and fifteen atmosphere percentage data obtained prior to the initiation of the field treatments. Field capacity and permanent wilting percentages were determined during the course of the field experiments. The field capacity values were larger than the moisture equivalents but the permanent wilting percentages were in agreement with the fifteen atmosphere percentages.

Percentages of the available water at 4, 12 and 20 inch depths were measured with gypsum resistance blocks of the Bouyoucos design. The gypsum blocks were found to be reasonably uniform under field conditions. Block readings made with a commercial impedance meter designed and calibrated to read "percent available water" agreed reasonably well with values for percent available water determined by sampling, especially for the range of 40 to 85 percent.

Evapo-transpiration rates for the crops were calculated from the changes in the available water, converted to inches of available water, and precipitation and irrigation

data. Evapo-transpiration rates were dependent upon the crop and time during the growing season as influenced by climatological factors. Peas had a peak rate of 0.190 inches per day during the last of June. Alfalfa had a peak rate of 0.187 inches per day in late July. The rates for tomatoes and sweet corn increased very rapidly during July to a peak of 0.207 inches per day in late July. Cabbage had a peak rate of 0.167 inches per day in mid-August.

Weather data including precipitation, evaporation, temperature, relative humidity, wind and solar radiation were recorded daily. A close relationship existed between evaporation and solar radiation, and between evaporation and vapor pressure deficit in the period April through September, while temperature lagged behind the other factors during August and September.

The mean ratio of evapo-transpiration to evaporation from a Weather Bureau pan was approximately 0.75. The evapo-transpiration rates and their relationships with climatological factors should be helpful in the design of supplemental irrigation systems and management practices for more efficient, economical production of irrigated vegetable crops in Northeastern United States.

244 pages. \$3.15. Mic 56-2422

ANATOMY

THE ORIGIN AND DEVELOPMENT OF THE
EXTRINSIC OCULAR MUSCLES IN THE TROUT
(SALMO TRUTTA) AND THE GAR PIKE
(LEPIDOSTEUS OSSEUS)

(Publication No. 18,268)

Charles William Bodemer, Ph.D.
Cornell University, 1956

The extrinsic ocular muscles originate according to a constant developmental pattern in elasmobranchs, reptiles, birds, and mammals. In two principal vertebrate groups, however, the origin of the eye muscles is unknown or imperfectly understood. The few reports on the origin of the eye muscles in ganoid fishes are of fragmentary nature, and the origin of the eye muscles in teleosts is completely unknown. The present investigation extends our knowledge of eye muscle development to include these two groups, and reveals that the six eye muscles in the gar pike and the trout derive from three separate anlagen, thus indicating a similar origin for these muscles throughout the vertebrates.

In the trout the prechordal plate, originally intimately associated with the anterior tip of the notochord and the anterior wall of the foregut, proliferates cells laterally and dorsally to form a prominent premandibular condensation on the caudomedial side of each optic vesicle. The premandibular condensations are usually solid in the trout. Initially the premandibular condensations are connected across the midline by a solid strand of prechordal mesoderm. This strand becomes attenuated and eventually degenerates; subsequently each premandibular condensation

gives origin to those muscles innervated by the oculomotor nerve. The mandibular and hyoid head cavities of other lower vertebrates are represented in the trout by homologous solid condensations, the anlagen of the superior oblique and external rectus muscles, respectively, within an area of unsegmented mesenchyme situated dorsal to the mandibular arch, lateral and caudal to the premandibular condensation. The external rectus anlage develops medial to the trigeminal ganglion and ventral to the vena capitis medialis. Cranial to the external rectus anlage an arm of denser mesenchyme extends from above the anterior end of the mandibular arch forward over the caudodorsal border of the optic vesicle. The posterior portion of this extended condensation subsequently regresses; the cranial part persists as the superior oblique anlage.

The prechordal plate in the ganoid Lepidosteus actively proliferates cells to form a premandibular condensation at the caudomedial surface of the eye. Early in its development several small lumina develop within each premandibular condensation; the lumina subsequently coalesce to produce a single large premandibular head cavity. Thereafter each head cavity expands rapidly, almost attaining the volume of the optic vesicle. A transverse strand of mesoderm unites the premandibular head cavities; in later stages a narrow canal, continuous with the head cavities, develops within the strand. The four eye muscles innervated by the oculomotor nerve originate as cellular proliferations from the walls of the premandibular head cavity; growth of the anlagen obliterates the cavity and, concomitantly, the transverse strand disintegrates. Mandibular and hyoid head cavities are absent in Lepidosteus, and there is no discrete area of mesenchyme dorsal to the

mandibular arch comparable to that mesenchyme which in the trout gives rise to the superior oblique and external rectus anlagen. The superior oblique in *Lepidosteus* originates as a diffuse mesenchymal condensation caudal to the optic vesicle. During subsequent development the anlage is gradually displaced cranially along the caudodorsal border of the optic vesicle, attaining a position adjacent to the craniomedial surface of the eye. The external rectus anlage develops caudal to the superior oblique condensation, medial to the trigeminus ganglion and ventral to the vena capitis medialis. No "muscle E" was observed.

The significance of the head cavities of vertebrates is discussed and the hypothesis developed that the cavities are mechanical expressions of a critical imbalance between rate and magnitude of cranial expansion and the proliferation capacities of the mesoderm in which the cavities appear. Measurements of the cranial area of *Lepidosteus* embryos at intervals of development are presented in support of this hypothesis.

224 pages. \$2.90. Mic 56-2423

MICROSCOPIC PROPERTIES OF WHOLE MOUNTS AND SECTIONS OF HUMAN BRONCHIAL EPITHELIUM OF SMOKERS AND NONSMOKERS

(Publication No. 17,178)

Suk Chul Chang, Ph.D.
Washington University, 1956

Chairman: Professor E. V. Cowdry

New method to make whole mounts of bronchial epithelium has been described and the differences of bronchial epithelium from smokers and nonsmokers have been studied through whole mounts and vertical sections.

1. Whole Mounts

- a. Epithelial whole mounts of nonsmokers generally showed fewer distended goblet cells than those of smokers.
- b. Occasionally in heavy smokers' whole mounts, where so many goblet cells are distended, sharply outlined localized areas containing only a few distended goblet cells were observed. These were hyperplastic in some cases and hypoplastic in others. Areas were also seen in which such changes were not so well defined at their margins, the distended goblet cells gradually decreased in number and completely disappeared. In such locations there were distinctive cellular irregularities, intercellular spaces, hyperchromatism, variable mitotic figures with atypical nuclei. These should be considered as either early stages of metaplasia or precancerous lesions, since their occurrence is similar to those of true carcinoma. Patterns of this kind were observed only in chronic heavy smokers who had smoked more than thirty years. They were not recognized in nonsmokers' whole mounts.
- c. In cases of bronchogenic carcinoma, with a history of long smoking, the appearance of whole mounts

was peculiar. The surface of epithelium was uneven and coarse furrows were observed. The nuclei were enlarged and no goblet cells were seen.

2. Vertical Sections

- 1) Examination of vertical sections confirm the observations made on whole mounts that distended goblet cells were more numerous in smokers than in nonsmokers.
- 2) The average length of cilia of smokers was shorter than that of nonsmokers.
- 3) The average thickness of epithelium of smokers was, however, thicker than that of nonsmokers.
- 4) The basal cell activity, epithelial indentation and intraepithelial inflammatory cell infiltration were more conspicuous in smokers than those of nonsmokers.
- 5) The occurrence of atypical cells was more frequent in smokers than in nonsmokers.
- 6) Metaplasia of bronchial epithelium was of more frequent occurrence in smokers than in nonsmokers and also more in males than in females. The age of maximum frequency was 50-69 years. 97 pages. \$1.50. Mic 56-2424

A HISTOLOGICAL STUDY OF THE POSTNATAL BOVINE TESTIS (*BOS (TAURUS) TYPICUS*)

(Publication No. 17,357)

Robert Gerard Fossland, Ph.D.
The University of Nebraska, 1956

Adviser: Andrew B. Schultze

The purpose of this study was to investigate the histological development of the postnatal bovine testis (*Bos (Taurus) typicus*). Fifty-six bulls from three dairy breeds were orchectomized unilaterally at fortnightly intervals at ages ranging from the first to the 83rd week post partum. Sections for microscopical examination were prepared by the paraffin method.

Testis weights were 2.5 grams up to one week of age and were 333 grams by the 83rd week. During this interval diameters of the seminiferous tubules increased from 45 to 280 microns.

Development of the germinal epithelium of the seminiferous tubules was divided into four stages, namely: I. The Neonatal Stage covering weeks one to 14 during which time the sustentacular cells and the spermatogonia differentiate from the primitive cells present at birth, and the first primary spermatocytes are observed. The epididymal tubules and the ductus deferens are patent and lined with a simple cuboidal or columnar type epithelium which gradually becomes pseudostratified during this period and the epithelium of the ductus deferens develops cilia. II. The Prepubertal Stage extending from week 15 through week 28 during which time the primary spermatocytes engage in active division both mitotically and mei-

otically and the first secondary spermatocytes are observed. Cilia were noted on the epithelial cells of the epididymal tubules by the 19th week. III. The Circumpubertal Stage beginning with the 29th week and ending with the 36th week. During this stage the secondary spermatocytes change to spermatids which attach themselves to the sustentacular cells and differentiate into spermatozoa, which become loosened and pass on out through the seminiferous tubules, rete, tubuli efferentes, epididymis and the ductus deferens. The epithelium of the epididymis and ductus deferens attains its mature thickness. By the 36th week the testis has become fully equipped, according to histological observations, to perform its function. IV. The Post Pubertal Stage beginning with the 37th week, involves a growth in weight of the testis and some increase in diameters of the seminiferous tubules but does not show any further developmental changes.

A number of interesting anomalies were observed during the course of the study as follows: a canalization of the epithelium of the ductus deferens; a disparity in thickness of the epididymal epithelium of different conical vessels; giant cells in the seminiferous tubules; retarded development in some individuals; vacuoles or canals in the epithelium of the epididymis; degenerating spermatocytes, both primary and secondary; one individual with a marked difference in testis weights in which the smaller testis was, on histological examination, found to be retarded; one individual which suffered a severe infestation with screw worms in the interval between orchectomies which caused a complete disintegration of the germinal epithelium in the second testis; and two animals who were badly undersized which showed an impoverished type of germinal epithelium, all elements being present, but sparsely.

It is felt that unilateral orchectomy performed at the interval practised is responsible for a compensatory hypertrophy in the second testis removed as evidenced by an increase in diameters of the seminiferous tubules and an increase in mitotic activity on the part of the spermatocytes. This compensatory hypertrophy is only slightly active in the neonatal stage, most active during the prepubertal and circumpubertal stages, and no effect was noted during the post pubertal stage.

185 pages. \$2.45. Mic 56-2425

A STUDY OF CHANGES IN FINE STRUCTURE DURING DEVELOPMENT OF MAMMALIAN EMBRYO EPIDERMIS

(Publication No. 17,193)

Max Gene Menefee, Ph.D.
Washington University, 1956

Chairman: Professor Edward W. Dempsey

By carrying out electron microscopy on the epidermis of timed embryo mice, the following information was obtained:

1. There is no continuity of tonofibrils from one cell to another. The tonofibrils insert upon the interior of the cell walls opposite each other but there is no intercellular bridge.

2. There seems to be a reciprocal relation between the amount of Golgi material and the number of mitochondria.

In addition, structures with an appearance intermediate between the two have been observed so that there may be a conversion of Golgi material to mitochondria; the opposite is probably not true because the Golgi material increases in amount first and is then followed by increase in mitochondria.

3. There is a close relationship between mitochondria and developing keratin fibrils. The nature of the relationship is such that the mitochondria may be spinning out the keratin protein into fibrils. If this is true, the function of protein synthesis must be assigned to mitochondria in addition to their other activities. Such an interpretation is thermodynamically possible because of the energetics of the mitochondrion.

4. There is a basement membrane associated with epidermis even at early stages. This membrane has fibrils from the dermis continuous with it, but there is no continuity whatever with epidermal structures.

60 pages. \$1.50. Mic 56-2426

SOME QUANTITATIVE HISTOLOGICAL STUDIES ON THE PRENATAL GROWTH OF THE LIVER IN THE GUINEA PIG

(Publication No. 17,259)

Virginia Briggs Peters, Ph.D.
University of Pennsylvania, 1956

Supervisors: L. B. Flexner and W. W. Chambers

Using quantitative histological methods the growth of the liver during the last half of gestation in the guinea pig has been analyzed with respect to several morphological parameters.

One micron sections of livers fixed in Regaud's fluid and cells freshly suspended in disodium versenate solution have been employed for the various measurements under phase microscopy. Axis measurements on hepatic cell nuclei in the cell suspensions were used to estimate individual and mean nuclear volumes. Mean nuclear volume was also estimated from the sectioned material by a new method which is essentially an adaptation of Chalkley's ('49) method applicable to thin sections. In addition, Chalkley's ('43) point count method was used on the sections to estimate the proportion of the liver represented by its various histological components. These measurements combined with measurements of organ weight and specific gravity at various gestation ages permitted the estimation of the contribution to the growth of the liver made by hepatic cells, extravascular blood-forming cells, blood and endothelium. In addition, growth by cell multiplication and growth by cell enlargement were distinguishable within the hepatic cell phase, and the rate of hepatic cell multiplication was calculated as a function of gestation age.

Two critical periods have been noted during the last half of gestation. The first, at about the 40th day, is marked by several changes which occur in the hepatic cell phase. Prior to this time it contributes a constant proportion to the growth of the organ by cell multiplication alone. After this time it contributes an increasing proportion to the growth of the organ by cell multiplication combined with cell enlargement. The cells undergo a three-

fold increase in size after the mitotic rate has undergone a four-fold reduction about the 42nd day. The mean nuclear volume remains constant throughout the last half of gestation. Therefore the increase in cell volume is due entirely to cytoplasmic accretion.

A second critical period about the 50th day is marked by changes in blood and extravascular blood-forming cells. Until this time the weight of blood has increased as a constant proportion of the organ weight. After the 50th day, the weight of blood increases but little and the proportion of the organ which it represents declines to about one-half.

Until the 50th day the weight of extravascular blood-forming cells increases almost linearly. After the 50th day it declines almost linearly. The proportion of the organ represented by blood-forming cells undergoes a ten-fold decline linearly from the 30th day to term.

49 pages. \$1.50. Mic 56-2427

THE EFFECTS OF CORTISONE AND ADRENALECTOMY ON THE GROWTH RATE OF THE EHRLICH MOUSE ASCITES TUMOR

(Publication No. 17,020)

Ben E. M. Watson, Ph.D.
Tulane University, 1956

Chairman: Ralph N. Baillif

Previous qualitative work has shown that cortisone tends to depress neoplastic growth, and adrenalectomy tends to enhance tumor growth. It was felt that quantitative determinations of the effect of the adrenal cortical hormone and of adrenalectomy on the Ehrlich ascites tumor should help to demonstrate the role of the adrenal cortex, and of cortisone specifically, in cancer growth.

The purposes of these experiments were: 1) to determine the effect of varying dosages of cortisone on the growth rate of the tumor; 2) to determine the effect of adrenalectomy on growth rate of the tumor; 3) to show the effects of the tumor and of excess cortisone on the tissues of the animals.

Ehrlich ascites tumor was injected intraperitoneally into Stocker Swiss mice in quantities from 11.0×10^6 to 13.0×10^6 cells. Cortisonized animals received 5.0 mg or 2.5 mg of the drug intramuscularly on the day of tumor

inoculation and on alternate days thereafter until 4 injections had been made. The animals were sacrificed on the ninth or tenth day after inoculation and the total cell count determined. Adrenalectomized animals were bilaterally adrenalectomized and given food and 0.9% saline with 12.5 mg/1 terramycin ad libitum; sham-operated animals received the same food and drinking fluid. All other experimental animals were given food and tap water ad libitum.

The animals that received 5.0 mg and 2.5 mg dosages of cortisone had tumor growth rates of 0.43 and 1.22 respectively, while controls showed a tumor growth rate of 4.91. When compared statistically, these rates are shown to be significantly different from each other and show that there is a depressing effect of excess cortisone on the tumor growth rate, and that this effect is proportional to the amount of the drug administered.

Animals that were adrenalectomized showed a tumor growth rate of 7.40 and sham-operated ones showed a rate of 4.64. These two rates were shown to be statistically different and indicate that the tumor growth rate is increased when the adrenal gland is removed.

One group of animals was given tumor and four 5.0 mg injections of cortisone but were not sacrificed until day 20. However, almost all of these animals died before the twentieth day. Data on only a few animals were obtained so that no valid conclusions could be drawn.

Histologic examination of the spleen, lymph nodes and thymus showed a reduction in lymphocytes and decrease in the size of the organs in mice receiving cortisone. The liver of these mice showed fatty metamorphosis, and there was a decrease in the width of the zona reticularis with loss of lipid and cells and an increase in the width of the sinusoids in the adrenal.

The lymph nodes of control animals showed hyperplasia and the adrenals showed some loss of lipid and increase in the width of sinusoids.

The experiments of other workers have shown an increase in antibody levels and a concomitant decrease in lymphocytes in the lymphoid organs following injections of adrenal cortical hormone, and a decrease in antibody levels in adrenalectomized mice. Other work has shown that the growth rate of certain ascites tumors is depressed by antibodies. Since it has been shown in the present experiments that cortisone depresses Ehrlich ascites tumor growth and adrenalectomy enhances the growth, it is suggested that the control of the adrenal cortex over the tumor growth rate is effected by the control of this gland on the antibody level.

61 pages. \$1.50. Mic 56-2428

ANTHROPOLOGY

SOCIAL IMPLICATIONS OF THE BOLIVIAN AGRARIAN REFORM

(Publication No. 18,282)

Richard Wilbur Patch, Ph.D.
Cornell University, 1956

The Bolivian agrarian reform does not conform to popular stereotypes of agrarian reform. The Bolivian reform,

far from being a mere legislative proposal, was in large part an accomplished fact even before it was recognized and regularized by the Decree-Law 3464 of August 2, 1953. Furthermore, the profound changes precipitated by the agrarian reform were social in nature and overshadowed even the far-reaching economic effects of the land distribution. Finally, the reform was the product of internal forces. Although the terminology of a European political movement has often been adopted to describe it, its sub-

stance is indigenous and its aim is intensely nationalistic.

There were a number of factors present in the Bolivian social, economic and political structure - at least until the 1930's - which contributed to the stable equilibrium which in turn perpetuated, until 1952, a socially and economically exploitive system.

Among the elements which supported the equilibrium were the following: First, the Bolivian social and economic systems were divided into two sectors, a world-oriented sector and a local-oriented sector - a condition which has been described in other underdeveloped countries as "dual" or "plural" economies. The local-oriented sector included the rural areas in which feudalistic tenure patterns persisted. The lack of integration of this sector with the social and economic sector oriented toward Western norms and world markets was an important factor in the stability of the system. A second factor supporting the equilibrium was a social stratification which tended toward caste closure. This imposed a social immobility and a focus upon intrinsic criteria of status, particularly in the ascription of an ethnic distinctiveness to the "indian."

These and other factors combined in the latifundio pattern to fix the peasant in a particular relation to the land and to the larger social and economic environment. The essence of the relation of the peasants may be summarized as an ineffective bargaining position which allowed the low supply price of labor to prevail over the demand price, or it may be more briefly stated as exploitation.

The nascent nationalism of the 1930's and particularly the nationalistic and catastrophic Chaco War set in motion forces which suddenly vitiated the institutions and values which had supported the stable equilibrium.

One of the products of the new forces was the emergence of an organized indigenous movement, which specifically originated in the province of Cliza in the department

of Cochabamba. A history of latent acculturation and a process of community rather than individual acculturation to mestizo norms facilitated the emergence of this movement.

The first objective of the emergent campesinos was to secure land. The movement remained incipient for fifteen years, but, after the successful revolution of the Movimiento Nacionalista Revolucionario in 1952, it became the powerful instrument of the sixty percent of the population of Bolivia who are considered indigenous.

The political party which came to power in 1952 was favorably inclined to land reform although it envisioned a more moderate set of objectives than was finally included in the sweeping agrarian reform which the campesinos, now armed and organized, initiated and which the government legalized.

The most widely felt results of the agrarian reform have been the changes induced by the destruction of the feudal latifundios, and the dispersion of an entire class of large landowners, together with the eradication of the concept of the ethnic distinctiveness of the "indians." Extrinsic, achieved status criteria are replacing intrinsic, ascribed criteria. The possibility of individual social mobility has been greatly enhanced, but change operates among the campesinos more in a process of community acculturation than in one of individual mobility. The new fact of land ownership, among former peasants, is encouraging geographical mobility. The immediate economic effect of the reform has been a proliferation of the minifundio, but as the social changes operate upon economic institutions new patterns may be expected.

In sum, the major accomplishment of the Bolivian agrarian reform has been the incorporation of a new class of campesinos into the national society.

312 pages. \$4.00. Mic 56-2429

BACTERIOLOGY

OBJECTIVE TECHNIQS IN BACTERIAL NUCLEAR CYTOLOGY

(Publication No. 18,293)

Howard Irving Adler, Ph.D.
Cornell University, 1956

Controlled qualitative experiments indicated that age of culture, nature of fixation, length of hydrolysis, and the particular stain employed could influence the final structure of the nucleus as observed by the currently popular staining technics.

It was observed that thionin-SO₂ and azure A-SO₂, introduced by DeLamater as modified Schiffs reagents, were, indeed, cytologically very similar to the classical Schiffs reagent. However, it was demonstrated that the role of SO₂ in these stains was not the same as its role in the classical Schiffs reagent. It could be shown that SO₂ was absolutely necessary in order to make pararosaniline, (the main component of the classical Schiffs reagent) specific for the nuclear structures of hydrolysed bacterial cells. The addition of SO₂ to azure A only intensified the staining,

it did not alter the specificity. For thionin, SO₂ could not be demonstrated to have any effect either on specificity or intensity. Furthermore, the addition of SO₂ to pararosaniline causes the disappearance of the normally intense red color. Color only reappears after contact with the hydrolysed cells. In thionin and azure A, SO₂ addition does not cause the disappearance of color. The reagents are intensely colored at all times. This may indicate an important chemical dissimilarity.

Giemsa stain has been shown to color a much larger and more irregular body than either Schiffs reagent or azure A-SO₂ or thionin-SO₂. It is obviously not specific for the same structures which the Schiffs reagent stains under the conditions of these experiments.

All attempts to observe nuclear structures in cells which have been fixed, hydrolysed, and stained in suspension have failed.

The difficulty encountered in staining cells in suspension led to a critical study of the fixation process. For this purpose, a novel quantitative method was developed.

The method depends on counting and classifying large numbers of photographed Feulgen positive structures in

cells fixed by various means. The cell samples are taken randomly and the classification is done in an objective manner. In each experiment, a highly standardized fixation treatment is included as a control. Using this method it could be shown that relatively slow drying fixations resulted in a high frequency of dumbbell shaped Feulgen positive bodies (21% to 38%) and other compact, intensely staining structures.

The variation in percentage of dumbbells among the slow drying fixations was shown to be statistically significant and indicated that treatment of dried cells with OsO_4 vapors before hydrolysis lowers the percentage of dumbbells whereas boiling methanol fixation increased the percentage as compared to the standardized control.

The fixation methods which involved rapid-drying or only partial drying resulted in more diffuse "mitotic" Feulgen positive structures, the frequency of dumbbell shapes in such preparations was less than one percent.

The quantitative data and the absence of discrete, internal Feulgen positive structures in cells fixed in suspension suggested that the bacterial nucleus may be a much more diffuse structure than is currently demonstrated.

By the quantitative method it was established that, in those fixations which yield high percentages of dumbbell forms, these forms tended to occur in groups rather than singly. The most logical explanations for this phenomenon were discussed and it was considered likely that adjacent nuclear structures were synchronized in their division as a result of common parenthood and similar environment and, as a result, tended to be morphologically similar.

Although Schiff's reagent was routinely used for quantitative studies, it was demonstrated that azure A- SO_2 or thionin- SO_2 could be employed with essentially the same results.

63 pages. \$1.50. Mic 56-2430

EFFECT OF MOISTURE LEVEL ON GERMINATION OF BACTERIAL ENDOSPORES

(Publication No. 18,112)

Russell James Beers, Ph.D.
University of Illinois, 1956

The germination of bacterial endospores and the growth of vegetative cells is dependent on the attendant moisture activity, defined as the relative humidity of the environment or of an atmosphere in equilibrium with it. Measurements of the moisture activities required for these processes were sought by three different methods. In the first, water was mixed in varying amounts with dried wheat flour containing spores in order to create desired moisture activities internally. The mixtures were incubated in closed containers at 30 C. and sampled at intervals for moisture determination and cell counts. In the second method dried smears of spores mixed with nutrients were prepared on glass slides which were incubated at 30 C. in desiccators over solutions of sulfuric acid designed to produce definite relative humidities, and stained at intervals to be examined for germinated spores or vegetative cells. In the third method high osmotic pressures and hence lowered moisture activities were produced in liquid media by dissolving large amounts of sucrose; germination

and growth in these media were determined by changes in optical density.

In the first of these methods, using old spores of *Bacillus cereus* var. *terminalis*, no evidence of germination or growth was observed even when the initial moisture activity was high, beyond a slight initial drop in spore count attributable to a lack of homogeneous moisture distribution, and which was not correlated with moisture activity. Furthermore the moisture activities of these mixtures decreased on standing, and it was concluded that under the best of conditions produced by this technique, the effective moisture activities were still too low.

On the slides germination became restricted when the sulfuric acid was stronger than 5% (98.4% relative humidity) and ceased over sulfuric acid stronger than 8% (97.3% relative humidity). In the sucrose solutions germination became restricted when the sugar concentration surpassed 20% (98.6% moisture activity) and failed to occur in concentrations greater than 30% (97.6% moisture activity). Spores from a fresher batch which had been stored in the wet frozen condition gave identical results. Spores of *Clostridium botulinum* Type B showed the same limit for unrestricted germination, but showed some activity in 31% sucrose (97.5% moisture activity).

Freshly prepared spores of *B. cereus* var. *terminalis* and *Bacillus subtilis*, harvested and stored without refrigeration, showed the same limit for unrestricted germination, but were tolerant to 35% sucrose (98.6% moisture activity) and 34% sucrose (97.0% moisture activity), respectively, before germination ceased. For *Bacillus megatherium*, the two limits were 21% sucrose (98.5% moisture activity) and 38% sucrose (96.3% moisture activity). Thus the storage history of the spores affects the moisture requirements for germination, and there are differences between species.

Growth of *B. cereus* var. *terminalis*, as indicated by turbidity measurements, did not occur in greater than 45% sucrose (94.6% moisture activity); for *B. subtilis* this limit was 46% sucrose (94.4% moisture activity), for *B. megatherium* it was 49% sucrose (93.7% moisture activity), and for *Cl. botulinum* it was 30% sucrose (97.6% moisture activity). Thus there are also species differences in the moisture activities required for growth as well as germination of spore forming bacteria, and in the case of the aerobic species at least, these requirements are lower than those required for the germination of their spores, in contrast to the relationship found by previous workers for fungi and their spores.

68 pages. \$1.50. Mic 56-2431

THE GROWTH OF HUMAN AND POULTRY
PLEUROPNEUMONIA-LIKE ORGANISMS IN
TISSUE CULTURES AND IN OVO AND THE
CHARACTERIZATION OF AN INFECTIOUS
AGENT CAUSING TENDOVAGINITIS
WITH ARTHRITIS IN CHICKENS

(Publication No. 17,233)

Leonard Hayflick, Ph.D.
University of Pennsylvania, 1956

Supervisor: Dr. Stuart Mudd

The pleuropneumonia-like organisms (PPLO) have been incriminated in such diseases of man as non-gonococcal urethritis and Reiter's syndrome. There is also some evidence that these organisms may be pathogenic for some rodents, chickens and many other domestic animals. The claims made by some workers that urethral scrapings from man contained PPLO inclusions and the resultant difficulties in proving that point prompted these studies. It appeared that the tissue culture technique would be well suited to studying the question of whether PPLO could be observed intracellularly. In addition to the Maximow double slide method and the use of Porter flasks, a new technique known as the hanging coverslip method was developed. This involved the use of coverslips in test tubes which received the suspension of tissue culture cells. Advantages are that a monolayer of cells is available on a coverslip, free of a clot, where ease of observation in the test tube and withdrawal for mounting for cytological studies is possible. Medium changes and additions are made with a minimum of risk of airborne contamination and a great saving in medium is made possible since 0.4 ml per test tube is used.

Chicken and human strains of PPLO were grown in the presence of chicken heart fibroblasts, HeLa cells and a line of human synovial cells. The organisms were also grown in the yolk sac of embryonated chicken eggs. The May-Greenwald and Giemsa stain and a modification of the Macchiavello stain were used.

The results of this work indicated that PPLO could be found to grow intracytoplasmically in certain cell types in tissue cultures. The yolk sacs of embryonated chicken eggs is well suited for the growth of PPLO and causes death of the embryo characterized by hemorrhagia. Intracytoplasmic inclusions were found in yolk sac cells that were similar to some inclusions found in the tissue culture cells.

Conclusions are that the developmental forms of PPLO observed in this study may have some bearing on the taxonomic position of these organisms. Mention is also made that in urethral scrapings from cases of non-gonococcal urethritis, intracytoplasmic inclusions may possibly be attributed to PPLO although extreme caution must be exercised. A tissue culture spectrum for PPLO is also discussed in relation to identification of these organisms.

The characteristics of a tendovaginitis or arthritis of chickens is described which in the gross includes weakness, emaciation, and anemia. The characteristics of an infectious agent isolated from these animals are elucidated by studies in embryonated eggs, filtration experiments, antibiotic sensitivity spectra, electron microscopy, tissue culture, and host range.

Conclusions are that cultures, stains, and darkfield

studies of material containing this agent were negative for spirochetes, bacteria, and PPLO. The yolk sac was the preferred route of inoculation, all of the embryos dying in 4 to 12 days. The agent passed through a bacteria-retaining filter, but with a drop in titer. Antibiotic sensitivity tests revealed that the agent was most sensitive to the tetracyclines, less sensitive to chloromycetin, dihydrostreptomycin, and resistant to penicillin. From electron micrographs it was concluded that the agent is a rigid, dense coccobacillus from 0.2 μ to 0.5 μ in size. The agent produced a cytopathogenic effect in tissue cultures of chick heart fibroblasts. The agent had no gross effect on suckling or newly weaned mice, pigs, or guinea pigs.

Reasons for suggesting that the agent is most similar to a rickettsia or possibly a large virus are discussed.

50 pages. \$1.50. Mic 56-2432

FACTORS AFFECTING THE GERMICIDAL
PROPERTY OF RAW MILK

(Publication No. 18,274)

Robert Walter Henningson, Ph.D.
Cornell University, 1956

It has been known since 1890 that raw cows milk will prevent or inhibit the growth of many micro-organisms. *Streptococcus pyogenes* is the only micro-organism known to be sterilized when subcultured in raw cows milk or whey. The germicidal property is generally called lactenin and defined in terms of its bactericidal effect on Group A streptococci.

The germicidal property is considered a result of the presence of a heat labile, bacterial inhibitor or the net effect of the interaction of several inhibitory and stimulatory substances which can be modified by heat treatment. Sulfur containing reducing agents modify the effect of the germicidal property also.

The purpose of this investigation was to study the germicidal property of milk with the concept that it results from a nutritional deficiency of the milk, rather than from the presence of an inhibitory substance.

A method was devised for the detection of the germicidal property consisting of incubation of *S. pyogenes* in sterile, raw whey prepared from cows milk and the subsequent enumeration of this micro-organism on meat infusion - blood agar.

Growth and death curves indicate that most, if not all, micro-organisms can be classed as sterilized, inhibited, or uninhibited as a result of exposure to the germicidal property. Results suggest that reducing substances do not permit the growth of *S. pyogenes* in raw whey but do eliminate the lethal effect for this micro-organism. Chemical compounds required by *S. pyogenes* did not permit multiplication or eliminate the lethal effect for this micro-organism but addition of complex media (meat infusion and yeast extract broths) overcame the germicidal property.

S. pyogenes has a requirement for heated ovalbumin and free sulphydryl groups in synthetic medium. It was shown that the times and temperatures required for elimination of the germicidal property are similar to those resulting in the presence of free sulphydryl groups (posi-

tive nitroprusside test) in raw milk and whey. No multiplication occurred until free sulfhydryl groups were present and growth decreased when free sulfhydryl groups diminished.

Addition of heated lactalbumin preparations, containing free sulfhydryl groups, to raw whey encouraged growth of *S. pyogenes* in this medium. This micro-organism did not grow when p-chloromercuribenzoate treated, heated, lactalbumin preparations were tested but cysteine reversed this effect.

The heat labile, germicidal property resides in the lactalbumin fraction of the milk serum proteins of which B-lactoglobulin, containing most of the sulfhydryl groups of milk, is the major component.

A biochemical method, based on the germicidal property of milk, for the differentiation of Group A and "Human C" streptococci was developed.

It was concluded that a deficiency of free sulfhydryl groups and/or denatured lactalbumin is a major cause of the germicidal property of milk.

43 pages. \$1.50. Mic 56-2433

EFFECTS OF GLUCOSE ON THE IN VITRO TUBERCULIN REACTION

(Publication No. 17,237)

Frank A. Kapral, Ph.D.
University of Pennsylvania, 1956

Supervisor: John A. Flick

The purpose of this investigation was to study in tissue culture the glucose utilization of normal and tuberculin sensitive guinea pig monocytes in the presence or absence of PPD. This study was extended in order to observe the effect of glucose on the *in vitro* tuberculin reaction.

Guinea pigs were sensitized with BCG and skin tested with PPD. The animals were given mineral oil intraperitoneally 48 hours prior to use in order to produce an exudate rich in monocytes. At the time of tissue culture the animals were killed by a blow on the head and the peritoneum washed out with Hank's solution. The exudate cells were washed, counted, and placed in Porter flasks. The monocytes were allowed to settle onto the glass and the other cells discarded.

Monocytes from either normal or sensitive animals normally adhered to the flasks and extended one or more pseudopods or membranes. Sensitive cells when exposed to PPD became round and the cytoplasm vacuolated until one or two large vacuoles completely filled the cell. This reaction began about 24-36 hours after exposure to PPD. No effect was noticeable with normal cells.

Glucose utilization was followed by culturing normal and sensitive monocytes in Porter flasks, the glucose and PPD being supplied in the medium. Controls without PPD were also run. Samples of medium were removed at intervals and analyzed for glucose by the method of Folin and Malmros.

The results of these experiments indicated that there was no difference in glucose utilization of sensitive monocytes in the presence or absence of PPD. However, it was noticed that the tuberculin reaction often appeared later than in cases where smaller amounts of glucose had been

available. For this reason experiments were done in order to study the effect of glucose on the reaction.

Cells from sensitive guinea pigs were exposed to PPD in the presence of low and high glucose concentrations. It was found that the higher level of glucose significantly delayed the onset of the reaction in tissue culture if the PPD was added after the cells had received the glucose. This delay varied from 2-10 days with different experiments. When PPD and glucose were added together at the start of an experiment the delay was not always apparent. In no case did high glucose levels actually inhibit the action of PPD on sensitive cells since such cells ultimately exhibited the same degree of injury as those provided with lesser amounts of glucose.

Experiments in which PPD was added to cultures after various periods of incubation were also performed. In these instances PPD was added to successive flasks immediately and after intervals up to 7 days. These studies demonstrated that sensitive monocytes could lose the ability to react to PPD when kept in tissue culture. This loss of reactivity occurred from 1-6 days after the start of an experiment and varied with each animal. Furthermore, this change in reactivity either appeared abruptly or extended over a 1-3 day period. In the latter case it became evident that some cells lost their susceptibility before others.

When PPD was added after various intervals to two series of cultures (all from the same animal), one containing a low level of glucose and the other a high concentration, both the delaying effect of glucose and the loss of cellular reactivity could be demonstrated in the same experiment. However, in the presence of the high concentration of glucose the cells retained their ability to respond to PPD for a longer period than did those cells provided with less glucose.

29 pages. \$1.50. Mic 56-2434

NUCLEIC ACID METABOLISM OF PLEUROPNEUMONIALIKE ORGANISMS

(Publication No. 17,248)

Raymond J. Lynn, Ph.D.
University of Pennsylvania, 1956

Supervisor: Harry E. Morton

The purpose of this investigation was to relate the nutritional requirements for nucleic acid derivatives with the metabolism of these compounds by a human strain of pleuropneumonia-like organism (PPLO).

First, the nucleic acid composition of the organism was determined by hydrolysis of the nucleoprotein and extraction of the nucleic acids with acid. Deoxypentose nucleic acid (DNA) and pentose nucleic acid (PNA) were determined quantitatively by colorimetric measurement of the sugar moiety and by determining the total phosphorus. The molar proportion of the purine and pyrimidine bases was determined in portions of isolated DNA and PNA. The separation of the two fractions was achieved by the selective destruction of PNA with mild treatment of alkali. The DNA was separated from such a suspension by precipitating it with hydrochloric acid. The precipitated DNA fraction was hydrolyzed with formic acid and the bases determined by chromatographic and spectrophotometric methods.

The purine bases of PNA were precipitated as their silver salts and quantitated by spectrophotometric methods. The pyrimidines were determined as their nucleotides in a binary mixture by utilizing the difference in their ultraviolet absorption spectra. In this organism the nucleic acid accounted for approximately 4 to 5 percent of the total dry weight of the cell. A ratio of PNA to DNA of 2.0 with 40 hour cells was found for PPLO. The bases of the DNA portion appeared to be present in nearly equimolar amounts. In the PNA fraction, the bases guanine and cytosine were present in amounts excessive of adenine and uracil. Methyl cytosine was not detected in these organisms.

In the second part of the investigation the requirement of the organisms for derivatives of nucleic acids necessary for their growth was determined. Experiments were conducted with a synthetic medium. When solid medium was preferred 1.5 percent agar was added. Growth was assayed in the liquid medium by making appropriate dilutions in saline and plating 0.01 ml of the dilution on regular PPLO medium. It was found that in the synthetic medium with agar added, the purine and pyrimidine bases plus the free sugars of d-ribose and d-deoxyribose would support growth of this organism. This was not the case in the experiment utilizing the liquid medium. Here, best growth was obtained when the deoxyribosides were incorporated. Attempts to use only ribosides were unsuccessful. It was found that exogenous deoxycytidine and thymidine were required before growth would take place in the liquid medium.

A deoxyribose phosphorylase was demonstrated in the third part of the investigation. Experiments were carried out in bicarbonate and Tris (hydroxymethylaminomethane) buffers with resting whole cells and cell free extracts of PPLO respectively. It was found that thymidine and deoxyinosine were split to their free bases and a phosphorylated sugar. Evidence was accumulated indicating that deoxyadenosine and deoxyguanosine also were split by this enzyme system. Inorganic phosphate was shown to be required in the reaction. Deoxycytidine was not attacked by this enzyme. It was further shown that the purine deoxyribosides could be formed by the reverse reaction. That is, when the free purine base was added to the reaction mixture containing the thymidine and enzyme system, the purine riboside could be recovered with the free pyrimidine base after the incubation period. However, under similar experimental conditions free pyrimidine base would not combine with the reaction product of a purine deoxyriboside and the enzyme. This observation is in agreement with the requirement for exogenous pyrimidine nucleosides demonstrated in the nutritional experiment previously described.

43 pages. \$1.50. Mic 56-2435

CYTOLOGICAL ANALYSIS OF ULTRA-VIOLET IRRADIATED *ESCHERICHIA COLI*:

I. CYTOLOGY OF *LYSOGENIC E. COLI* AND A NON-*LYSOGENIC* DERIVATIVE II. ULTRAVIOLET INDUCTION OF *LYSOGENIC E. COLI* III. REACTIONS OF A SENSITIVE STRAIN AND ITS RESISTANT MUTANTS

(Publication No. 17,257)

Irving John Payne, Ph.D.
University of Pennsylvania, 1956

Supervisor: Dr. Stuart Mudd

The dissertation is composed of three related studies; each is treated as a separate whole. It involves, firstly, the study by light and electron microscopy of the normal cytology of the *E. coli* strains under investigation, secondly, the sequences produced in lysogenic *E. coli* K12 and two defective lysogenic derivatives after ultraviolet induction and infection with exogenous lambda phages, and finally, the cytological sequences of wild-type *E. coli* B, an ultraviolet survivor, B/r, and a Furacin resistant strain, B/F, each after exposure to ultraviolet irradiation, Furacin, and hypertonic sodium chloride.

Logarithmic phase cultures were grown in nutrient or synthetic media. For cytological preparations, cultures were either seeded densely upon agar plates, which were subsequently irradiated for various periods, or were spread upon agar containing different concentrations of Furacin or NaCl. Blocks were cut from these plates at intervals after incubation; where studies were conducted in liquid media, aliquots were placed upon agar blocks to imbibe excess moisture. These blocks were exposed to 2% OsO₄ vapours for one minute in order to fix the cells. Impressions were made upon coverslips which were then processed and stained either by the DeLamater Azure A-SOCl₂ dehydration technique, or by the May-Grünwald modification of Hartman and Payne. Preparations for electron microscopy were made by the technique of Beutner, Hartman, Mudd, and Hillier and were generally shadowed slightly with chromium.

The percentage of the different strains surviving exposure to ultraviolet irradiation was determined by diluting aliquots of irradiated cells in saline or buffer and plating them on agar. Appropriate precautions were taken to prevent photorestitution. Survival of strains on Furacin or NaCl was determined by spreading diluted samples directly upon agar containing various concentrations of Furacin or NaCl.

The action of sublethal amounts of ultraviolet radiation on *E. coli* produces the following sequences of cytological changes: a) the chromosomes of the nuclei of irradiated cells coalesce slightly; b) chromosomes of pairs of adjacent nuclei flow together into one mass so that, instead of 2 or 4 chromosomal clusters, there are 1 or 2 aggregated masses per cell; c) further increase in chromatin due to chromosomal replication without nuclear or cytoplasmic division; d) grouping of chromosomes; e) segregation of chromosomes into haploid nuclei; f) resumption of cytokinesis. Changes a) through c) follow a similar pattern whether the *E. coli* treated is lysogenic K12 or its non-lysogenic derivative strains, or strain B or its radiation or Furacin resistant mutants. In the presence of an in-

ducible prophage, however, recovery stages d) through f) do not occur. Rather, chromosomal fragmentation and the accumulation of chromatic material progress and lysis occurs with the liberation of infective phage.

Exposure to sublethal concentrations of Furacin is followed by similar sequences in strains B and B/r; B proceeds to extreme filament formation and to radially enlarged cells; in B/r these changes are less extreme and of shorter duration. In highly resistant B/F, changes following exposure to any tolerated dose of Furacin are minimal.

The survivors of strains B, B/r, and B/F on NaCl agar showed changes similar to those following brief irradiation and exposures to low doses of Furacin, and, as with these latter agents, the aberrations in *E. coli* B were more extreme and of longer duration than in strains B/r and B/F.

The similarity of cytological events after exposure to various treatments makes attractive, as one possible explanation, the mechanism described by Whitfield and Murray for several microorganisms subjected to a variety of injurious agents. The alteration in the configuration of chromatin appears to be a secondary consequence of the failure of a homeostatic mechanism regulating the internal ionic milieu. Inhibition of cell division appears also to be secondary to a primary injury.

72 pages. \$1.50. Mic 56-2436

SOME NUTRITIONAL NEEDS AND METABOLIC ACTIVITIES OF SELECTED FLAVOBACTERIA

(Publication No. 18,337)

Herbert Norman Prince, Ph.D.
The University of Connecticut, 1956

The genus *Flavobacterium* comprises a nutritionally heterogeneous group of bacteria. The organisms studied can be divided into 2 large groups: (1) those that can utilize NH_4^+ as a sole source of nitrogen when provided glucose, maltose, or, to a lesser extent, sucrose or pyruvate, and (2) those that require organic nitrogen compounds for growth. For those that fall into group 1, exogenous vitamins may or may not be required. In this category, *Flavobacterium aquatile* (700), *Flavobacterium suaveolens* (958), *Flavobacterium esteroaromaticum* (8091), and *Flavobacterium flavescens* (8315) required or were stimulated by biotin (0.1 μg per ml), thiamine, and Ca-D-pantothenate (1.0 μg per ml each). The biotin was replaced by pimelic, oleic, and aspartic acids as well as desthiobiotin and tween-80. Thiamine was replaced by the thiazole moiety, cocarboxylase, and, to a slight extent, 2-methyl-5-ethoxymethyl-6-amino pyrimidine. Ca-D-pantothenate was replaced by β -alanine, pantethine, and coenzyme A. All replacements were effective at 10 μg per ml. Growth in the presence of Ca-D-pantothenate and biotin was inhibited by pantoyltaurine (100 μg per ml) and avidin (0.5 per cent) respectively. Concentrations of pyrithiamine and oxythiamine up to 1000 μg per ml did not inhibit growth in the presence of thiamine (1.0 μg per ml).

The amino acid L-cysteine, urea, and NH_2OH were toxic (10 $\mu\text{moles N}$ per ml) to the 4 cultures studied when added to the otherwise satisfactory glucose- NH_4Cl -vitamin-salts medium. This toxicity was reversed by

structurally unrelated amino acids (histidine, proline, isoleucine) as well as Mg^{++} . The NH_4^+ was replaced by alanine, serine, aspartic and glutamic acids, asparagine, glutamine, histidine, proline, hydroxyproline, and tryptophan at a concentration of 10 $\mu\text{moles L-isomer nitrogen}$ per ml.

Cultures 700, 958, 8091, and 8315 oxidized all intermediates of the citric acid cycle, although rates on the di- and tricarboxylic acids were slow when compared to oxidation of glucose and acetate. Marked differences were observed among these 4 organisms with respect to rate and extent of oxidation of citric acid cycle intermediates, formate, and glucose.

The enzymic activities of pyruvic oxidase, citrogenase, isocitric dehydrogenase, and fumarase were demonstrated in cell-free extracts of acetone powders of aerobically grown cells. The product of isocitrate oxidation was α -ketoglutaric acid.

The activity of whole cells and cell-free extracts is preliminary evidence for the existence of the citric acid cycle in the 4 flavobacteria studied. Its quantitative significance is unknown.

The ability of cultures 700, 958, 8091, and 8315 to grow in the glucose- NH_4Cl -vitamin-salts medium was temporarily lost when the cells were transferred a few times in casitone-beef extract agar. Replicate plating experiments and turbidimetric studies of rate of growth indicated that a population of *Flavobacterium esteroaromaticum* (8091), when grown in a complete medium, was capable of bifurcating into 2 cultural types differing with respect to rate of growth in minimal medium. This bifurcation was reversible; i.e., a rapid-growing culture was converted into a slow-growing culture by repeated transfer in complete medium. Conversely, a slow-growing culture was made to grow quickly (48 hours) after 2 culture cycles in minimal broth. The high frequency of reversion in either direction indicated that a mutational event was not being encountered. The exact genetic mechanism is unknown.

97 pages. \$1.50. Mic 56-2437

A STUDY OF THE VACCINIA VIRUS IN STABLE STRAINS OF TISSUE CELLS CULTIVATED IN VITRO

(Publication No. 17,107)

Fred Ward Ryden, Ph.D.
Vanderbilt University, 1956

Supervisor: Professor Charles C. Randall

During recent years, investigators at the National Institutes of Health adapted cultures of a mouse fibroblastic cell (strain L, Earle) to growth on glass substrates and developed methods for the handling and maintenance of replicate cultures on a large scale. Subsequently, stable strains of tissue cells have proved highly suitable for both applied and fundamental investigations of animal viruses.

Although the virus of vaccinia has been studied extensively, interest has been centered primarily on the late stages of infection, and its propagation in cultures consisting of cells of one histological type has received no significant attention. Since monolayer cultures of stable

strains of tissue cells provide a readily manipulated system for definitive studies concerning the fundamental aspects of host-virus interaction from inception to completion of the infectious process, a two-fold experimental investigation was undertaken which included: (a) a study of the capacities of different strains of vaccinia to proliferate in stable cultures of mammalian cells and the cytologic changes induced by viral infection, and (b) a study of the reproductive cycle of vaccinia virus correlated with concurrent cytologic changes. Cultures of two mouse fibroblastic cells (strain L, Earle; strain LLC-M1, Hull) and a malignant epithelial cell (strain HeLa, Gey) were employed in conjunction with three viruses having varied infectious potentialities - a neurotropic strain (WR), a dermatotropic strain (Minnesota), and a tissue culture strain (Rivers).

Differences in the abilities of the viruses to proliferate in the cellular strains were demonstrated. Viral reproduction occurred in six of the nine cell-virus systems that were investigated. All three viruses multiplied in HeLa cultures, the WR and Rivers strains multiplied in LLC-M1 cultures, and only the WR strain multiplied in L cultures. Propagation of the viruses was established in accordance with accepted criteria and the cultivated viruses were identified immunologically. Viral proliferation was char-

acterized by the formation of typical intracytoplasmic inclusion bodies and by the development of progressive degenerative cellular changes which produced complete destruction of the cultures within 48 to 72 hours after inoculation.

One of the cell-virus systems (WR strain in HeLa cells) was employed for a sequential study of viral reproduction in the presence and absence of immune serum, the composite results of which are as follows: (a) viral replication was characterized by a latent period of 8 to 10 hours followed by successive increases in concentration at intervals of about 8 hours to produce a maximal virus titer of 10^{-6} within 48 hours after inoculation; (b) infective intracellular virus was not demonstrable from the fourth to the tenth hour after inoculation, although Feulgen-positive inclusion bodies were present at six hours; (c) progeny virus was released from the cells more slowly than it was formed, and increase in concentration of newly formed extracellular virus coincided with progressive cytopathogenic changes resulting in marked cellular disintegration within 48 hours after inoculation.

The implications of the experimental findings were discussed and suggestions for further investigation of host-virus relationships during the early stages of infection were presented. 157 pages. \$2.10. Mic 56-2438

BIOLOGY-GENETICS

SEROLOGIC CHARACTERIZATION OF AN ETHANOL EXTRACTABLE SUBSTANCE PECULIAR TO RAT NEOPLASMS RELATED TO CERTAIN NATURAL HEMAGGLUTININS PRESENT IN THE NORMAL RAT

(Publication No. 17,214)

Arthur E. Bogden, Ph.D.
University of Pennsylvania, 1956

Supervisor: Paul M. Aptekman

This study is concerned with the fundamental problem of the serologic differentiation of normal and neoplastic tissues. A phenomenon observed in tumor-bearing animals involving certain natural heteroagglutinins has been utilized to serologically characterize an ethanol extractable substance peculiar to the rat neoplasms studied.

Desiring to simulate, as closely as possible, the homogeneity that appears to exist between a spontaneous tumor and its host, two inbred albino rat strains and transplantable tumors which originated spontaneously or that were induced by means of methylcholanthrene in these strains were used. Thus, it is felt that such relatively strong antigens as those specific for species, strain and even subline differences as well as histocompatibility factors have been eliminated, or at least minimized, in these studies.

The dissertation consists of three distinct but inter-related phases.

PHASE I. Disappearance of natural heteroagglutinins from the sera of rats with progressively growing tumors.

Studies were made on the heteroagglutinin activity of sera from normal and tumor-bearing rats of two highly inbred strains. A striking difference was found in their reaction to suspensions of human red blood cells. The incidence and titer of these natural heteroagglutinins is related to the age of the rat. These agglutinins begin to appear in the sera between the ages of 60-90 days, reaching consistently higher titers for blood cells of groups O and AB after 180 days of age. Fifteen hours after implantation of homologous tumor tissue in rats of the P.A. or Lewis strain, an appreciable drop in the heteroagglutinin titers for cells of both O and AB blood groups occurred. The maximum immediate drop was reached in 48 hours. Thereafter, there was a rise in titer, which reached a peak in 6-9 days. After 9 days there was a gradual and increasing drop in titer until the hemagglutinins disappeared entirely after 21 days. There was an inverse relationship between hemagglutinin titer and progressive tumor growth.

PHASE II. Characterization of the natural hemagglutinins in normal rat serum associated with a negative phase following tumor implantation.

Natural heteroagglutinins for human red cells present in the serum of normal, mature rats, showing a "negative phase" in antibody titer following tumor implantation, have been characterized. This study revealed that the natural hemagglutinin peculiar to P.A. strain serum, reacting with human blood groups AB and A cells was serologically related to the blood group A specific substance. None of the natural heteroagglutinins reacting with blood groups B and O cells was serologically related to either the blood group

B, or the O (H) specific substances. The antibody causing agglutination in low titer of group B and O cells was shown to be reacting with a substance common to cells of all the 4 blood groups. Trypsinization of cells of all 4 blood groups appears to "uncover" an antigen common to all of the cells. The ability of normal rat serum to agglutinate the normal human group B and O erythrocytes would seem to depend upon the presence of an antigen on the cell surface. There was no indication that the natural hemagglutinins characterized in this study are heterophile or anti-species antibodies.

PHASE III. Ethanol extraction and serologic characterization of a tumor peculiar substance related to the hemagglutinin disappearance phenomenon. Using natural hemagglutinins present in normal rat serum two ethanol extractable substances have been serologically characterized. Since it was demonstrated by Aptekman and Lewis that ethanol extracts of rat sarcomata possessed immunizing as well as oncolytic properties, tissue extraction by the method of Aptekman and Lewis was decided upon for these studies.

A non-dialyzable (cellophane membrane) component, peculiar to the several rat neoplasia studied, was found to be serologically related to the natural anti-a hemagglutinin. A dialyzable factor, common to both normal and neoplastic tissues, was found to be serologically related to the hemagglutinin that reacts with human erythrocytes of all four blood groups.

A pronounced negative phase in humoral antibody titer was produced by injecting the ethanol extract of tumor tissue subcutaneously. The in vivo drop in titer was similar to that which followed subcutaneous inoculation of viable tumor tissue.

Block titrations using normal rat serum and ethanol extracts of four rat tumors, showed a characteristic and similar pattern, whereas similar extracts of normal muscle appeared to be unreactive.

72 pages. \$1.50. Mic 56-2439

**A STUDY OF THE FLIGHT HABITS OF THE
EUROPEAN CHAFER, AMPHIMALLON
MAJALIS RAZOUMOWSKY (SCARABAEIDAE)**

(Publication No. 16,997)

William George Evans, Ph.D.
Cornell University, 1956

Biological studies were conducted on European chafer, *Amphimallon majalis* (Raz.) adults during flight periods of 1953, 1954 and 1955, in the vicinity of Newark, New York. These insects emerge each evening during the months of June and July, swarm around trees for about a half hour, and eventually settle on the trees to mate until dawn when they return to the soil.

By measuring the light intensity at the time of emergence and by conducting experiments in a cage in which the light intensity could be altered, it was found that emergence, though not necessarily flight, took place at light intensities ranging from 13 to 32 foot-candles. Some unknown factor or set of factors is involved in the migration of the adults to the surface of the soil where light stimulates emergence, and in causing the chafer to fly, since

lowered light intensities can bring about emergence, but not flight, during the day.

The flight range and orientation of the chafer were studied by collecting large numbers of beetles from trees, by shaking them onto a polyethylene sheet placed on the ground, marking them with fluorescent lacquer-enamels, and releasing them at different distances from a tree. Beetles were collected from the tree again and examined under an ultra-violet light for recaptures. The percentage of recaptured marked beetles released at different distances on the same evening from several trees has been correlated with the apparent sizes of the trees at the distances of the release sites. Through observation and experimentation it has been shown that the size of the silhouette determines the flight goal of the European chafer after it emerges from the soil in the evening.

Marked beetles that had been released up to 725 yards away were recaptured from a 30-foot-high hickory and it is believed that in wooded areas such as are found in central New York the flight range of the chafer in one evening does not greatly exceed this distance. If this distance is multiplied by the median number of nocturnal flights made by the adult a theoretical distance of about two miles could be flown during the life of the chafer providing the flight was made in the same direction each evening.

A record was kept of the longevity and frequency of flight of 86 beetles in a large field cage by marking each beetle with different colored enamel spots. It was found that the males emerged a median number of five times whereas the females emerged a median number of 4.5 times; yet both males and females lived a median number of six days.

A pattern of population succession was found to occur during the flight period in the field cage where distinctly separate, though overlapping, populations successively emerged at different periods throughout the flight season. The population with the greatest numbers emerged from July 3 to July 9 in 1954. 64 pages. \$1.50. Mic 56-2440

**THE PRODUCTION OF POLYPLOID FORMS IN THE
EASTER LILY, LILIUM LONGIFLORUM VARIETY
GIGANTEUM HORT., WITH SPECIAL REFERENCE
TO TRIPLOIDS**

(Publication No. 18,338)

Yoneo Sagawa, Ph.D.
The University of Connecticut, 1956

The important role which polyploidy has played in the development of many cultivated plants and its uses as a "tool" for the horticultural improvement of many genera has been known for some years.

Among the 80 to 85 species of the genus *Lilium*, there are no polyploids, except for a common form within the species *tigrinum*, which is a triploid and several recently produced tetraploids, induced by colchicine treatment. The triploid tiger lily surpasses the diploid form in beauty, vigor, floriferousness, adaptability and ability to maintain itself through vegetative propagation of bulbils. Therefore, this investigation is an attempt to use polyploidy in the improvement of another group within this genus. The Easter lily (*L. longiflorum* variety *giganteum*) was selected

for this investigation because of its relatively large chromosomes and the ease of growing and forcing into flower at different times of the year. Until recently, there were no polyploids within this group.

The diploid stud plants were the clones Croft, Creole, Estate and two seedlings LWQAustr38 and USDA44. The diploids were found to be self-incompatible and generally cross-compatible. The possible causes of self- and cross-incompatibility of Easter lilies is considered. The stigmatic fluid contains no inhibitor for pollen germination. The haploid and diploid pollen grains tested germinated and the pollen tubes traversed the entire length of the style of the diploid clone Croft even in crosses which are incompatible. The incompatibility reaction thus occurs just prior to or at fertilization.

A substantial number of tetraploids was produced by intercrossing and subsequent selfing of the progeny of two colchicine-induced tetraploids previously produced by the United States Department of Agriculture. These tetraploids are slower-growing plants producing fewer and heavier-textured flowers than the diploids. Since triploids among other groups have been shown to possess intermediate characters between diploids and tetraploids, reciprocal crosses were made between the diploids and tetraploids. From 853 reciprocal crosses, 131 seedlings were obtained consisting of 112 diploids, 7 tetraploids, 2 triploids, 1 hypotriploid with 34 chromosomes and 11 unclassifiable plants (1 albino, 10 which died during the seedling stage). Only one of the triploid plants is growing normally. The production of two triploids after 850 pollinations is held to be significant when one considers the tremendous number of pollinations made annually among tulips, narcissi and hyacinths, the number of seedlings screened for the detection of polyploids, especially triploids, and the relatively small number of triploid clones of these groups available today in commerce.

A previously produced colchicine-induced polyploid, which was thought to be tetraploid, proved to be a chimera of interesting composition and is reported on in some detail. When the plant produced two side bulbs, both of which were removed and grown separately, they were found to be different from the parent plant. One division, the central bulb, is probably a mixochimera; one side bulb, a periclinal chimera with a tetraploid epidermis and diploid internal core; and the other bulb, a tetraploid. The constitution of plants produced through vegetative propagation from stems, bulb scales and basal bulblets of the three divisions is reported.

Although intended primarily as a study of the mechanism of producing triploids in the Easter lily, *L. longiflorum* variety *giganteum*, these investigations add considerably to our basic knowledge of the plants belonging to this rather broadly defined group. In the course of these studies, a series of problems has been uncovered and much of the future progress in the improvement of this widespread and commercially important plant may depend on the pursuit and understanding of these basic problems.

146 pages. \$1.95. Mic 56-2441

A STUDY OF CHANGES IN FISHING EFFORT, ABUNDANCE, AND YIELD FOR YELLOWFIN AND SKIPJACK TUNAS IN THE EASTERN TROPICAL PACIFIC OCEAN

(Publication No. 17,145)

Bell Masayuki Shimada, Ph.D.
University of Washington, 1956

The rapid growth of the Eastern Pacific fishery for yellowfin and skipjack tunas since the end of World War II has given rise to pragmatic questions concerning the rational utilization of these resources. As part of the Inter-American Tropical Tuna Commission's program of research designed to investigate these problems, a study was undertaken to determine from the historical records of the fishery the effects of fishing upon the stocks of yellowfin and skipjack tunas of the Eastern Pacific region and to evaluate the present condition of these stocks with respect to the maximum equilibrium yield.

These objectives were approached by a method of analysis based upon the concept that if the variations in population size from fishery dependent factors are large, relative to the effects of fishery independent factors, there should be a measurable relationship between changes in population size with changes in intensity of fishing, considering the Eastern Pacific tuna populations as discrete biological units. The essential measurements of total yield, population abundance in terms of the standardized catch per unit of effort, and fishing intensity were obtained from the quantitative records of the operations and results of the California tuna fishing fleet for the series of years from 1934 to 1954.

It was concluded from the inverse relationships exhibited between changes in apparent abundance and fishing effort that the amount of fishing has had a real effect upon the stock of Eastern Pacific yellowfin tuna taken in the aggregate over the period studied. The evidence suggests also that for this species the intensity of fishing in the last few years has reached and might even have exceeded the level corresponding to the maximum equilibrium yield. For skipjack, no correlation was found between changes in population size with changes in fishing intensities thus far encountered indicating that the fishery has had little, if any, apparent effect on the abundance of this species. If these results are meaningful, it appears that further increases in the total catch of yellowfin tuna above that already attained cannot be expected from increased fishing effort whereas for skipjack, it seems possible to increase the average annual catch on a sustained basis without detriment to the welfare of the resource.

130 pages. \$1.75. Mic 56-2442

BOTANY

TOBACCO MOSAIC VIRUS INFECTION OF BEAN AS INFLUENCED BY LEAF TREATMENTS

(Publication No. 18,126)

James Lowell Dale, Ph.D.
University of Illinois, 1956

Plant tissues mechanically inoculated with virus are commonly rinsed with water after inoculation, but it has been reported that this procedure and excessive exposure to water considerably reduce the amount of infection. To determine the cause of this effect and to help define the process by which viruses initiate infection when mechanically applied to host, bean leaves inoculated with tobacco mosaic virus were subjected to various rinse treatments soon after inoculation. Leaves inoculated with virus in 0.1M phosphate buffer at pH 8.5 and immediately rinsed in distilled water for periods up to 1 minute showed sharply decreased infection, with the 1 minute rinse causing a 75% decrease in infection. Leaves rinsed 1 minute in solutions of different pH produced more infection at pH 3.0 than at 3.7 or 5.5 and a pH 9.5 rinse produced maximum infection which slightly exceeded that produced by a pH 8.5 rinse. Leaves rinsed in water of different temperatures showed decreased infection as the temperature was increased from 5 to 45°. Reduced infection from rinsing leaves in distilled, de-ionized, and tap water was correlated with the pH of the solutions. Water rinses reduced infection more in old leaves than in young leaves. The optimum phosphate salt concentration for infection was .05M when leaves were rinsed 1 minute in pH 8.5 phosphate buffers. Glycine and borate buffer rinses at pH 8.5 produced similar amounts of infection at all concentrations tested, and caused 65 and 78% as much infection as controls rinsed in phosphate. Bean leaf extract added to rinse solutions did not appreciably influence infection. An acid rinse treatment reduced infection more in leaves inoculated at the time of injury than it did in leaves inoculated by injuring and immersing in virus solution. Application of pH 8.5 Na phosphate, carbonate, and sulfite solutions to leaves after inoculation caused approximately a 70% increase in infection when applied immediately, and little or none when applied 1 and 4 hours after inoculation. Sodium sulfate caused minor infection increases at all time intervals tested. Leaves rinsed in NaCl and CaCl₂ solutions showed greatly increased infection as the salt concentrations were increased up to 0.1M. At the same concentrations FeCl₃ solutions caused lesser increases in infection. Distilled water sprayed onto and collected from uninjured and injured leaves was changed from pH 6.3 to approximately pH 7.6. It is concluded that distilled water rinses reduce infection primarily because they have a slightly acid pH, and that effects of many of the rinse treatments upon infection were mainly dependent upon the H-ion and salt concentrations of the rinse solutions. It is reasoned that the rinses influenced attachment of virus particles to the surface of protoplasm of injured cells of the test plant.

65 pages. \$1.50. Mic 56-2443.

VARIATION IN CULTIVATED VARIETIES OF HUMULUS LUPULUS, AND ITS RELATION TO THE POSSIBLE SOURCES OF THESE VARIETIES

(Publication No. 17,179)

Edward Lyon Davis, Ph.D.
Washington University, 1956

Chairman: Edgar Anderson

A study of many of the important cultivated varieties of hops is presented. Upon the basis of cone (axis and bracts) and leaf characters, three complexes have been established. Two of these morphological complexes are composed of cultivated varieties centered in Europe, one in North America. A preliminary investigation of herbarium material of wild growing hops also emphasizes the separateness of an American race, while suggesting potential variability within it. Ono's cytological studies are shown to lend support to this distinctiveness of the American type.

The nomenclature of the genus Humulus is briefly reviewed. Particular attention is given to the American taxa which have been proposed. The genus is treated as being composed of two species, H. lupulus L. and H. japonicus Sieb. and Zucc. The various races mentioned above are too imperfectly known taxonomically in the wild for the precise delimitation of varieties or sub-species.

The morphological variation within clones over a wide geographical range and for the two years 1954 and 1955 has been studied and found to be slight, in opposition to the popular concept of adaptability of cultivated hop varieties.

The effect of pollination upon the cone axis, in altering the degree of condensation and angularity, is measured. Preliminary experiments in stimulating cone growth without producing seeds, by interspecific pollination of H. lupulus with H. japonicus are described.

The arrangement of cones upon the vines has received special attention. It is found to be very variable and greatly modified by the environment, though there are characteristic differences between varieties in the degree of clustering.

A brief review of the uses and history of hops is presented. Attention is called to the use of hops in the making of yeast (and therefore of bread) which may have preceded its use in beer. No attempt is made to establish a definite point of origin of cultivation from historical information, but the importance of hops in the folklore of Eastern Europe is brought out. The suggestion is made that hops were most probably cultivated in Northeastern Europe and the Caucasian region long before they were cultivated in Western Europe. The history of hops has indicated how drastically man has altered this distribution and how difficult it is to establish a range for the prehuman elements in the genus.

111 pages. \$1.50. Mic 56-2444

STUDIES ON THE EFFECT OF RNA AND
XANTHINE ON ROOTS OF INBRED AND
HYBRID TOMATOES IN VITRO

(Publication No. 17,438)

Sigmund Leonard Doerpinghaus, Ph.D.
Louisiana State University, 1956

Supervisor: Professor Lewis H. Flint

Recent studies in the role of nucleic substances in metabolism have been largely restricted to adventitious tissues. Since such knowledge may be elucidated by use of less distorted growth systems, excised tomato roots were used as a test medium for this study with nucleic materials. In addition, the place of genetic factors in such phenomena has been approached through the use of known, genetically stable plant materials.

The growth of excised tomato roots was studied in medium with ribose nucleic acid (RNA), desoxyribose (thymo) nucleic acid (DNA), alkaline hydrolysate of RNA and DNA, uridylic acid, cytidylic acid, guanylic acid, adenylic acid, uracil, uridine, xanthine, hypoxanthine, and uric acid. Of these, there appeared effects distinctive to the strains in RNA and xanthine medium. Growth data were taken over a four-weeks culture period and studied in light of other investigations. Supplemental studies of impurities in the substances used were also carried out.

RNA completely inhibited roots of strains 103 and 154, but had little effect on the growth of roots of strain 151. Roots of 103 x 154 were also inhibited, but roots of 103 x 151 were slightly stimulated and roots of 151 x 154 were only slightly inhibited. Xanthine stimulated the growth of roots of strains 151 and 154, but proved quite inhibitory to roots of 103. Roots of 103 x 151 and 151 x 154 were highly stimulated, while those of 103 x 154 were inhibited to about the same degree as those of 103.

It was concluded that RNA and xanthine must certainly enter the metabolism of excised roots or affect it significantly. The exact mechanism is not certain. The place of RNA and xanthine (and possibly other related substances) in the physiology of plant growth may well be dependent on genetic constitution. 59 pages. \$1.50. Mic 56-2445

STUDIES ON THE CONTROL OF
PINK ROOT OF SHALLOT

(Publication No. 17,441)

Thomas Edward Freeman, Ph.D.
Louisiana State University, 1956

Supervisor: Dr. E. C. Tims

It has long been apparent that some method of controlling pink root of shallots is needed. Especially is this need pressing in the shallot area of Southern Louisiana. Therefore, a study was made concerning possible control measures and factors related to control of the disease.

It was found that chemicals reported to have reduced the disease in Colorado were not effective under Louisiana conditions. When 44 fungicides were assayed in the laboratory, it was found that seven would kill the pink root fungus at rates which were practical on a field basis. Six

of the seven fungicides were organic mercury compounds. The seven fungicides were: Agrox, Ceresan M, Manzate, Mergamma, Mersolite 8, Semesan and Setrete. In greenhouse tests it was noted that Mergamma and Mersolite 8 were phytotoxic. Field tests showed that the greenhouse test was reliable in the case of these two materials since they also showed toxicity there. Field tests also showed that all seven fungicides, with the exception of Mergamma, significantly reduced the incidence of pink root when applied to the opened row as a drench. The chemicals were applied at a concentration of 100 ppm in relation to the weight of the treated soil. This would be approximately eleven pounds per acre on six-foot rows and seventeen pounds on four-foot rows. Semesan, Setrete, and Agrox in that order gave very good control of the disease and the use of any one of these materials may well become an efficient and practical control measure. The results of the study tended to show a correlation between laboratory and field testing of fungicides. However there was no consistent correlation between laboratory, greenhouse, and field tests. Laboratory and greenhouse tests alone did not appear to be completely accurate in determining the effectiveness of the fungicides under field conditions.

The study revealed that a four-year rotation plan was not suitable for control of the pink root disease. It also showed that heat treatment of pink root infected shallot sets at temperatures up to 56° C for 60 minutes was injurious to the sets and did not rid them of the fungus.

The results of the study may well form the basis for a practical control of the pink root disease of shallots.

60 pages. \$1.50. Mic 56-2446

STUDIES ON THE AUXIN LEVELS OF HEALTHY
AND VIRUS INFECTED PLANTS

(Publication No. 17,362)

John Paul Jones, Ph.D.
The University of Nebraska, 1956

Adviser: William B. Allington

A study was made of the auxin levels of comparable healthy and virus diseased plants using several procedures for auxin extraction and assay.

Ether extractions were made of fresh tissue of several lots of healthy and tomato spotted wilt virus infected tomato and tobacco plants. The extracts were concentrated and assayed for auxin by means of the Avena coleoptile section test, the tomato seedling epinasty test and paper chromatography. No auxin was detected by these procedures. Ether extractions were also made of alkaline hydrolyzed plant tissue, and the extracts assayed as before with no auxin being detected.

Auxin was obtained by a method of concentrating the expressed juice of comparable healthy and virus diseased plants in a vacuum distillation apparatus. The concentrates were assayed for auxin by a technique that combined paper chromatography and the Avena section test. The concentrates were chromatographed on paper and sections of the paper cut out, placed in dishes, covered with water and Avena coleoptile sections floated on the resulting solutions. The concentration of auxin in the solutions was de-

terminated by the amount of elongation of the coleoptiles.

Six experiments were done following this technique using groups of healthy and tomato spotted wilt virus infected tobacco plants. The auxin levels of the diseased plants were found to be greater than those of the healthy plants in five of the experiments. The increase in auxin level in the diseased plants was found to be significant in one case, highly significant in two cases, and non-significant in two cases. In the sixth experiment, the healthy plants had a significantly greater auxin level than the diseased. There was some indication that the auxin level in healthy tobacco plants may vary uniformly with the season.

Two experiments with groups of healthy and tomato spotted wilt virus infected tomato plants showed significantly greater auxin levels in the diseased plants than in the healthy.

In two experiments with groups of healthy and tobacco mosaic virus infected tomato plants, one showed a highly significant increased auxin level for the diseased plants and the other the converse, which was non-significant.

The auxin measured in the plant extracts in the experiments appeared to be the natural auxin indole acetic acid.

The results of the study indicate that the auxin economy of tobacco plants infected with tomato spotted wilt virus, and tomato plants infected with tomato spotted wilt and tobacco mosaic viruses is affected by the disease. Apparently the auxin level was increased in the specified virus diseased plants, but whether or not the increase was great enough to be responsible for some of the symptoms of virus disease was not determined.

68 pages. \$1.50. Mic 56-2447

THE MORPHOLOGY OF THE PANICLE IN THE CULTIVATED SORGHUMS

(Publication No. 17,189)

Harold Joseph Kidd, Ph.D.
Washington University, 1956

Chairman: Edgar Anderson

1. A general survey of the vegetative and panicle morphology of cultivated and weed sorghums is presented. The materials studied included conventional herbarium specimens, commercial varieties, and detailed observations of the behavior of panicle characters in two F_2 hybrids.

2. The cultivated grain sorghums are shown to have developed the following panicle modifications, most of which are associated directly or indirectly with increased inflorescence size (and hence with yield):

- a. Recurving of the peduncle ("gooseneck").
- b. Tortuous branches.
- c. Condensation of nodes, evidenced by:
 - i. The presence of a terminal spray of branches which have a long sterile zone.
 - ii. Alternate elongation and suppression of internodes in branches of the inflorescence.

3. The effects of pressure on the above three characters are discussed.

4. The color and color pattern of the mature spikelets are described. The sorghums exhibit the following two extremes:

- a. Color in haphazard patches, glumes not shiny.
- b. Color in regular pattern, glumes shiny.

5. The sorghums are tentatively classified in three broad groups, two of them based on information from experiment and observation, and a third based on general studies. The geographical distribution of these groups is discussed. Though based on different types of evidence, this classification shows strong correlations with those proposed by previous students of the genus. A possible germplasm-cytoplasm interaction was encountered in a cross between representatives of two of these groups.

83 pages. \$1.50. Mic 56-2448

AN EXPERIMENTAL STUDY OF VARIABILITY IN A WILD POPULATION OF VIOLETS

(Publication No. 17,253)

Pauline Monz Miller, Ph.D.
University of Pennsylvania, 1956

Supervisor: Dr. John M. Fogg, Jr.

A population of wild stemless blue violets—*Viola sagittata*, *V. papilionacea* and hybrids between the two species—which was growing in the vicinity of Newtown Square, Delaware County, Pennsylvania was studied to determine the causes of the extreme variability found in the population. The two main purposes of this study were to evaluate the effect of ecological factors and the effect of hybridization on the variability in this population.

The effect of environment on the variability was studied by making a comparison between plants in the field and plants transplanted to the greenhouse at the University of Pennsylvania. Leaf shape was found to be a plastic character under different environmental conditions. For purposes of obtaining a quantitative measure of change in leaf shape, a method was devised for making blueprints of leaves, from which measurements were made and a numerical index of leaf shape was derived.

Other characters which were scored—peduncle length, petiole length, amount of pubescence, numbers of cilia, habit of capsule and plant and color of capsule and seed—were also combined in an index form. From observations in the field and greenhouse, it was concluded that leaf shape and pubescence are subject to change under varying environments, but that the other characters scored are stable and do not change.

Experiments in which plants were subjected to different day lengths showed that leaf shape in *V. sagittata* and hybrids similar to this species is influenced by the day length. Leaf shape in *V. papilionacea* is not affected by photoperiod. A similar correlation between leaf shape and day length was demonstrated for plants growing in the field. No photoperiodic effect was evident on any of the other characters studied, and the variation found was assumed to be genetic.

This variation which is not environmentally determined can best be accounted for by occasional hybridization between the two parental species, followed by obligatory selfing of the hybrid in cleistogamous flowers. In this way the parental characters which are segregated in the gametes are recombined by selfing in the cleistogamous flowers to form an F_2 generation which is extremely variable and shows recombinations of the parental characters in many forms intermediate between the parental types. Selfed progeny of unknown and known parentage verify this conclusion.

71 pages. \$1.50. Mic 56-2449

ELECTRON MICROSCOPE STUDY OF THE PLANT CELL WITH SPECIAL REFERENCE TO THE OSMIOPHILIC PLATELET

(Publication No. 17,483)

Newtol Press, Ph.D.
State University of Iowa, 1956

Chairman: Dr. Harold W. Beams

An electron microscope study of the plant cell was made primarily in an effort to resolve the question of the existence of osmiophilic platelets as discrete structures in the plant cell, and also to provide evidence concerning the validity of the postulated homology of platelet and dictyosome. In the course of the investigation, information was also gathered as to the fine structure of cell walls, vacuoles, fat bodies, plastids, mitochondria, endoplasmic reticulum, and the nuclear envelope.

Root and shoot apices of *Cucurbita pepo*, *Hordeum vulgare*, and *Vicia faba* were prepared for electron microscopic examination by fixing 45 minutes to 2 hours in OsO_4 buffered at pH 7.7, embedding in methacrylate polymer, and sectioning at 0.025μ .

The osmiophilic platelet was found to be a discrete structure, consisting of a relatively structureless central region surrounded by two lamellae that are separated by an interlamellar region. Fine fibrils and granules are found within the interlamellar regions of some platelets. Portions of some platelets, most often the inner lamellae, display marked osmiophilia. Since the fine structure of the osmiophilic platelet does not resemble that of the dictyosome, homology of platelet and dictyosome is thought to be improbable.

The internal structure of plastids includes dense spherical bodies, small granules, and starch or clear areas presumably indicating the previous presence of starch.

Primary cell walls were found to be composed of fibrils arranged in layers, and to be penetrated by plasmodesmata. Plasmodesmata were demonstrated to provide cytoplasmic continuity between adjacent cells, an arrangement possibly facilitating intercellular transport.

Cell vacuoles are structurally empty except for residues of ergastic substances and the tonoplasts which delimit the vacuoles.

The observation that fat bodies appear to lack constant shape, and definite limiting membranes may be indicative not only that the fat bodies occur as ergastic substances rather than as formed structures, but also that fat bodies are fluid within the living cell.

The fine structure of mitochondria and endoplasmic reticula in the plants studied is similar to that observed in other plants and some animals.

The nuclear envelope is composed of a double membrane perforated by annuli.

49 pages. \$1.50. Mic 56-2450

EFFECTS OF MALEIC HYDRAZIDE ON PHOTOSYNTHESIS AND RESPIRATION OF RED KIDNEY BEAN

(Publication No. 17,367)

Lazern Otto Sorensen, Ph.D.
The University of Nebraska, 1956

Adviser: Rufus H. Moore

The effects of maleic hydrazide on photosynthesis and respiration of red kidney bean leaves were studied in the botany greenhouse at the University of Nebraska during the summers of 1953 to 1955. The diethanolamine salt of maleic hydrazide was added to the nutrient solution of aerated water cultures at concentrations of 100 and 200 ppm. Adding the chemical to the nutrient solution was found preferable to spraying it on the shoot, in that plants were affected more uniformly. The effect of spraying 1,000 ppm was found to give effects approximately equal to that secured by adding 100 ppm to the nutrient solution.

The air-stream method was used to measure the rate of carbon dioxide absorption during photosynthesis or the release of carbon dioxide during respiration. All tests were made on the middle leaflets of the first trifoliate leaves. Each leaflet under test was placed in an especially constructed chamber from which air was passed through an absorption tower containing dilute potassium hydroxide. Six towers were operated simultaneously: two for tested leaflets, two for control leaflets, and two as checks on the carbon dioxide content of the greenhouse air.

Photosynthetic and respiratory rates of plants treated with maleic hydrazide were expressed as percentages of rates for controls. Photosynthesis was initially stimulated by maleic hydrazide. After reaching a peak within about three days, the rate steadily declined until the leaf abscised or the plant died. The rate of photosynthesis at the conclusion of a test period was approximately one-fourth that of the controls. Respiration was also stimulated during the first few days. The peak of respiration, which was slightly higher than that of photosynthesis, was reached in about four days, and was followed by a steady decline similar to that for photosynthesis. The rate of respiration at the termination of a test period was approximately one half that of the controls.

Plants treated with concentrations of maleic hydrazide greater than 200 ppm in preliminary tests died so soon after treatment that they were not included in the program finally adopted. The rates of both photosynthesis and respiration were stimulated slightly more by 200 ppm than by 100 ppm of maleic hydrazide.

41 pages. \$1.50. Mic 56-2451

CHEMISTRY

CHEMISTRY, BIOLOGICAL

A SPECTROPHOTOMETRIC METHOD FOR THE DETERMINATION OF SUBMICROGRAM AMOUNTS OF NICKEL IN HUMAN BLOOD

(Publication No. 17,602)

Maxwell Lewis Cluett, Ph.D.
University of Virginia, 1956

A method has been developed for the determination of nickel in human blood and may, of course, easily be extended to other biological materials.

Blood is drawn into a sterilized hypodermic syringe equipped with a special platinum-ruthenium alloy needle. Sodium heparin is added as an anticoagulating agent. The sample is wet-ashed with nitric acid in an open Pyrex vessel on a hot-plate at 330°C. The mineral constituents are converted to chlorides by evaporation to dryness from strong hydrochloric acid solutions. Iron(III), copper and lead interfere in the spectrophotometric procedure for nickel and hence must be removed. Iron and copper are separated by an ion exchange procedure, based on the selective adsorption of these metal ions on Dowex-1 anion exchange resin from 7.0-7.5 molar hydrochloric acid solution. Following the ion exchange procedure, lead ions are separated by their selective "adsorption" on calcium carbonate from neutral or alkaline solution. The average recovery from solutions containing known microgram amounts of nickel is 100 ± 4 per cent when passed through the Dowex-1 column, and 98 ± 5 per cent, from similar solutions contaminated with lead, upon passing through the calcium carbonate column. The spectrophotometric procedure is based upon the extraction from alkaline solution of the complex formed between nickel and diethyldithiocarbamate. Isoamyl alcohol is the extracting solvent and the absorbance is measured at 325 m μ in a 1-cm. cell. The procedure has an absolute sensitivity of 0.0048 γ of nickel per cm.² for an absorbance of 0.001 unit. The gram atom absorptivity is 37,000. The standard deviation in determining 0.5 microgram of nickel is 4.0 per cent.

The isolation, separation and spectrophotometric procedures were used as an analytical method for the determination of nickel in human whole blood samples and one plasma sample. Ten-milliliter samples were analyzed and the nickel concentration in whole blood was found to range from 0.020 to 0.090 part per million; the average concentration in blood from eight patients was 0.041 part per million. The concentration of nickel in the plasma sample was 0.012 part per million.

The application of photoelectric spectrophotometry in trace analysis is reviewed. Two methods are available, depending on the choice of references for setting the zero and 100 instrument readings. One method is specifically applicable for trace analysis when solutions sufficiently concentrated to permit optimum conditions are not available. An experimental working curve and the standard

deviation of each method have been determined for our procedure for traces of nickel.

124 pages. \$1.65. Mic 56-2452

CHROMATOGRAPHIC PROCEDURES FOR THE ISOLATION OF THE ORIGINAL CONSTITUENTS OF NATURAL WAXES, WITH SPECIAL REFERENCE TO THE STUDY OF OURICURI WAX

(Publication No. 17,385)

Leslie John Norman Cole, Ph.D.
The Ohio State University, 1956

Findley and Brown used molecular distillation complemented by functional group analysis to calculate the original composition of some plant waxes. With adsorption chromatography, however, they experienced difficulties that were due to disruptive effects of alumina on wax constituents. Fuchs and deJong separated beeswax by this method into groups of functionally homogeneous compounds, but resolutions which reflect the true nature of plant waxes have not been effected hitherto.

The objective of the investigation was to separate the original constituents of a plant wax into functionally homogeneous groups by using adsorption chromatography, and thus to facilitate the complete elucidation of the true nature of plant waxes. The research was conducted in three stages. First, a satisfactory method was developed which provided an adequate separation of a known mixture into four groups, viz., dotriacontane, octadecyl stearate and stearone, octadecanol, and stearic acid. The adsorbent was alumina (Fisher), washed for 30 minutes in one per cent aqueous HCl, then with water to give a neutral pH. The activity, designated 2a, was such that when a 10 ml. aliquot of a solution of two dyes (20 mg. each dissolved in benzene-petroleum ether 1:5) was chromatographed on 5.5 g. of the alumina in a column 1.3 cm. diameter, sudan yellow (upper) and p-methoxy-azobenzene separated, with the sudan yellow band beginning 0.7 cm. from the top of the column on development with 20 ml. of the same solution free of dye.

This grade 2a alumina, when prepared fresh, did not give a satisfactory separation of spermaceti wax, but, on re-use after regeneration by exhaustive washing with methanol and water, spermaceti wax was resolved into esters (95.4 per cent), alcohols (2.6 per cent), and acids (1.2 per cent). These successful conditions were found inapplicable to candelilla and ouricuri waxes.

Candelilla wax was altered during chromatography. Functional analyses indicated that hydrocarbon (41 per cent), simple n-esters, hydroxy esters, free acids, and free alcohols were present. Alumina (M. Woelm), anionotropic pH 4.0 and grade 4 (which permitted the complete removal of p-methoxy-azobenzene from the test column

but left sudan yellow as a band beginning 4.0 cm. from the top), was found to be the best starting adsorbent for the separation of the original constituents of ouricuri wax. This wax was resolved by chromatography on alumina into four major classes (9 fractions), with a minimum of alteration of the naturally occurring components. The first fraction, eluted in the initial separation by heptane, was re-chromatographed on silica gel and found to contain hydrocarbons, simple n-esters, and a very small amount of alcohols. The second fraction of the initial separation, eluted with one per cent propanol in heptane, was re-chromatographed on silica gel and found to contain simple n-esters, a mixture of free alcohols, and hydroxy-mono-esters. The third and fourth fractions, eluted by 5 per cent propanolic heptane and benzene-ethanol (2:1) respectively, consisted predominantly of hydroxy-di-esters. Fraction 5, removed by one per cent acetic acid in heptane, consisted exclusively of acids, while the material in the succeeding fraction, which was eluted with 0.5 per cent acetic acid in benzene, was calculated as hydroxy-monoesters. This fraction contains a significant amount of acidic material. The seventh fraction, removed with 5.0 per cent acetic acid in benzene, appears to be a very high molecular weight hydroxy-acidic-poly-ester. The remaining material was found to be resins and was eluted by 5 per cent acetic acid in benzene-ethanol (1:1).

The estimated composition of ouricuri wax (in per cent) derived from these separations is: hydrocarbons 1.2; simple n-esters, 23.6; hydroxy-mono-esters, 25.4; hydroxy-di-esters, 14.1; hydroxy-acidic-poly-esters, 5.4; resins, 14.8; free acids, 8.7; free alcohols, 3.0; moisture, 1.4; and ash (inorganic matter), 0.4.

106 pages. \$1.50. Mic 56-2453

STUDIES IN EXPERIMENTAL LATHYRISM

(Publication No. 17,440)

Harold Paul Dupuy, Ph.D.
Louisiana State University, 1956

Supervisor: Professor Jordan G. Lee, III

The effects and specificity of added dietary protein on the development of lathyrism were studied. Attempts were made to find a single chemical measurement which would serve as an objective index of these effects. In these experiments, albino rats of a local strain were used as test animals. When the rats weighed approximately 50 gm, littermates were matched for sex and weight, housed singly and fed the lathyrogenic rations. Weight, food consumption and a summation of their general condition were recorded daily.

Protein supplements promoted weight gain and retarded skeletal changes in rats fed lathyrogenic rations, but all proteins were not equally effective. Technical grade casein, vitamin-test casein and lactalbumin were equally effective. Gelatin was not too effective in promoting weight gain, and zein was not too effective in retarding skeletal changes.

Tryptic and acid casein hydrolyzates promoted weight gain and retarded skeletal changes in lathyrogenic rations.

The ten essential amino acids required by the rat, when fed as a group, promoted weight gain and retarded skeletal

changes in lathyrogenic rations, but not as effectively as casein. When fed as a group, histidine, isoleucine, leucine, methionine and phenylalanine were slightly effective in retarding skeletal changes but did not promote weight gain. When fed singly, phenylalanine or histidine may have retarded skeletal changes to a slight extent.

When fed singly, methionine promoted weight gain, but this was due to a methionine deficiency in Singletary pea protein and not a deficiency induced by the toxic material.

The variation in the protective influence of the different proteins studied is probably due to differences in amino acid content and the liberation rate of these amino acids.

Casein was not primarily involved in the exacerbation of paralysis. Paralysis seems to be induced by an increase intake of toxic material plus growth stress. The rat on the casein supplemented ration ate more than the rat on the basal ration; therefore, the rat on the casein supplemented ration ingested more toxic material.

None of the chemical measurements which were made seem to meet the requirements as a desirable objective index of the protective effect of protein, but some changes in values have been observed.

The ratio of wet bone weight to total body weight was increased, the level of bone calcium and phosphorus was decreased, the creatinine coefficient was decreased, the creatine coefficient was increased, and the concentration of muscle creatine was increased in the rats fed the basal ration as compared to the rats fed the casein supplemented ration.

The concentration of bone alkaline phosphatase, bone nitrogen and hydroxyproline, and thigh muscle nitrogen appeared to be the same in the rats fed the basal ration as the rats fed the casein supplemented ration.

66 pages. \$1.50. Mic 56-2454

SOME BIOCHEMICAL CHARACTERISTICS OF GUINEA PIG MAMMARY TISSUE IN VARIOUS FUNCTIONAL STAGES

(Publication No. 18,298)

Peter George Heytler, Ph.D.
Cornell University, 1956

Chairman: Walter L. Nelson

The growth rate, pentosenucleic acid (PNA) and deoxy-pentosenucleic acid (DNA) content, mitochondrial content and several enzymes involved in carbohydrate and in lipid metabolism were studied in homogenates of guinea pig mammary glands taken at various stages of pregnancy, lactation and involution. Rapid growth was found to begin late in pregnancy and to reach maximum rate during first two days after parturition. Fresh weight, total nitrogen content, DNA content and PNA/DNA ratio exhibited marked increases closely paralleling one another. This is in contrast with the reported behavior of these values in the rat mammary gland. An increase of sevenfold or more in mitochondrial nitrogen, as recovered by differential centrifugation, was observed between early pregnancy and lactation.

Anaerobic glycolysis and aldolase activity were found to be moderately low in early pregnancy and during lacta-

tion. Both underwent a pronounced (over threefold), brief increase during late pregnancy, preceding the onset of rapid growth. Glucose-6-phosphate dehydrogenase and 6-phosphogluconic dehydrogenase exhibited low activity throughout pregnancy, rose in activity to several times this value during lactation and decreased rapidly during involution.

Fatty acid activating enzymes were determined in the mitochondria, the microsomes and the soluble fractions of mammary tissue, as prepared by differential centrifugation. Characteristic substrate specificities were exhibited by the enzymes of each of these fractions. The soluble fraction acted only upon short chain acids, showing a maximum activity toward acetate (C_2). Medium chain-length fatty acids, particularly laurate (C_{12}) were activated by the mitochondria while the microsomal fraction exhibited a specificity for higher acids (optimum of C_{16} or higher). The specific activity of all fractions was low during pregnancy and increased sharply about the time of parturition.

63 pages. \$1.50. Mic 56-2455

FACTORS AFFECTING EARSHOOT DEVELOPMENT IN DENT CORN

(Publication No. 18,153)

Edgar Inselberg, Ph.D.
University of Illinois, 1956

INTRODUCTION

The number of earshoots produced by several hybrids of dent corn is rather uniform, generally ranging from 7 to 9 per plant. Yet the number of earshoots developing into mature ears varies widely among hybrids compared at low rates of planting. The maximum number of mature ears that can be produced by a given hybrid is considered subject to genetic control. The actual number of ears obtained is apparently determined by environmental factors. The mechanism within the plant determining which of the earshoots develop into ears was investigated.

MATERIALS AND METHODS

The single crosses of dent corn used in the various phases of this work were grown on the Agronomy South Farm. The earshoots that were sampled for subsequent analysis were husked, frozen, and lyophilized. The carbohydrate analyses were conducted by a modified Munson-Walker procedure; the nitrate analyses by a modification of the phenoldisulfonic acid method; the mineral analyses by a spectrographic method; and the indoleacetic acid analyses according to the procedure developed by Gordon and Weber with some modifications.

RESULTS AND DISCUSSION

1. A morphological study of WF9 X C103 and L317 X R4 revealed that the earshoots eventually developing into mature ears began growing at a faster rate than the remaining earshoots approximately one week before silking.

2. The single cross L317 X R4 was selected for intensive study, because it was the most uniform in the number of ears produced.

3. As the rate of planting increased the silking date of each earshoot was delayed. Within each rate of planting the earshoots silked successively down the plant at approximately one day intervals on the average.

4. As the rate of planting increased the mean number of ears per plant decreased.

5. Undisturbed plants produced 2.01 ears per plant at the rate of one per hill, 40 X 40 inches. The upper two earshoots developed into mature ears on all the plants, whereas the third earshoot set some seed only on one percent of the plants. When the uppermost earshoot was removed at silking, 100 percent of the third earshoots set seed. The percentage of third earshoots setting seed and the size of ears produced by the third earshoot decreased exponentially as the removal of the uppermost earshoot was delayed. Preventing the upper one or two earshoots from pollinating resulted in the development of small ears by a considerable percentage of third earshoots.

6. The chemical composition of the upper three earshoots of L317 X R4 from plants at one per hill, 40 X 40 inches, was essentially the same two days after silking. However, only the upper two earshoots developed into full-sized ears, while the third earshoot developed only on one percent of the plants, setting a few kernels. Approximately two weeks after silking the third earshoots were considerably higher in reducing sugar, nitrate, P, K, Ca, Mg, Fe, Mn, Zn, and B than the upper two earshoots. The third earshoots were considerably lower in sucrose and indoleacetic acid than the upper two shoots at this time. When the third earshoot was induced to develop by removing the uppermost earshoot at silking the composition of the third earshoot tended to become similar to that of the second earshoot.

7. Continued growth of the upper two earshoots, which is correlated with increasing concentrations of indoleacetic acid results in the transformation of osmotically active substances such as sugars into osmotically inactive substances such as starch and cellulose. The translocation of nutrients into the developing earshoots is thus continued. The failure of the third earshoot to develop into an ear was associated with low concentrations of indoleacetic acid throughout the sampling period.

125 pages. \$1.70. Mic 56-2456

A STUDY OF PRECURSORS, INTERMEDIATES AND AN INHIBITOR INVOLVED IN REACTIONS OF THE BIOSYNTHESIS OF PURINES

(Publication No. 17,243)

Bruce Levenberg, Ph.D.
University of Pennsylvania, 1956

Supervisor: Dr. John M. Buchanan

The biosynthesis of the purine mononucleotide, inosinic acid, has been investigated with the aid of several partially-purified enzymes obtained from pigeon liver extract. Using various N^{15} -labeled substrates, it was demonstrated that the amino-nitrogen atom of L-aspartic acid and the amide-nitrogen atom of L-glutamine served as the elementary precursors of N_1 and N_3 , respectively, of the purine ring system. This work brought to completion our knowledge of the precursors of each carbon and nitrogen atom

comprising the basic structure of the purines.

Several intermediate compounds involved in the synthesis *de novo* of inosinic acid were isolated from enzymatic reaction mixtures by ion-exchange chromatography and characterized by chemical analysis and metabolic behavior. They were assigned the following structures: Glycinamide ribotide (I); (α -N-formyl)-Glycinamide ribotide (II); (α -N-formyl)-Glycinamidine ribotide (III); 5-Aminoimidazole ribotide (IV); 5-Amino-4-imidazole carboxamide ribotide (V). (I) was formed by reaction between glutamine, 5-phosphoribosylpyrophosphate, glycine and ATP, and was converted to (II) in the presence of "active formate" and a tetrahydrofolic acid derivative. (III) arose from (II) by reaction with ATP and another mole of glutamine. Cyclization of (III) next occurred in the presence of ATP to form (IV), which was converted to (V) upon reaction with aspartic acid, carbon dioxide, and ATP. Purification of the enzymes responsible for these transformations was accomplished by fractionation with ethanol and ammonium sulfate and by adsorption on gels.

A marked inhibition of purine biosynthesis *de novo* in this system was noted upon inclusion of the anti-tumor agent, L-azaserine, in the incubation medium. The site of this effect was traced to the severe inhibition exerted by this antibiotic on the conversion of (II) to (III). Azaserine was found to act in competition with glutamine in this reaction and kinetic evidence was obtained for an irreversible binding between the inhibitor and an active site on the enzyme surface. 223 pages. \$2.90. Mic 56-2457

THE ENZYME, ASCORBIC ACID OXIDASE. EXPERIMENTS WITH RADIOACTIVE COPPER.

(Publication No. 17,097)

Richard Joseph Magee, Ph.D.
Columbia University, 1954

Ascorbic acid oxidase is, as the name implies, an enzyme which catalyzes the aerobic oxidation of ascorbic acid. The ascorbic acid oxidase from the squash, *C. pepo* *condensa*, is known to be a copper-protein containing six atoms of copper per molecule. In this present investigation radioactive cupric ion (Cu^{64}) has been employed in continuing the effort to learn more about the state of the copper in the enzyme and the role which the copper plays in the enzymatic process.

It has been found that when the enzyme functions, i.e. catalyzes the aerobic oxidation of ascorbic acid, in the presence of radioactive cupric ion, Cu^{64} is rapidly incorporated into the enzyme. However, resting (non-functioning) enzyme incorporates Cu^{64} at a very much slower rate. These observations confirm those made in preliminary experiments in these laboratories by previous investigators (M. Joselow and C. R. Dawson, J. Biol. Chem. 191, 1, 11(1951)). From the results of the previous investigation it was not possible to decide whether the incorporation of radiocopper into functioning ascorbic acid oxidase was due to the enzyme's functioning process or to the marked inactivation which the enzyme simultaneously underwent. Evidence is now presented which indicates that the inactivation process is not the causative factor.

The techniques employed for most of this work were

based on those of Joselow and Dawson, particularly in regard to the use of columns of cation-exchange resin for the separation of the enzyme from extraneous radiocopper at the end of the reaction time. In addition, a new technique was introduced for the removal of this extraneous copper. This involved the removal of the cupric ion as a complex with ethylenediaminetetraacetate by passage through an anion-exchange resin. The experimental results obtained with the two methods were in close agreement with each other. The new method promises to be of value in studying the kinetics of the exchange process.

A number of experimental variables have been examined as possible factors in determining the amount of radiocopper incorporated into resting and functioning ascorbic acid oxidase. It has been found that increasing the time of contact between Cu^{64} and the resting enzyme results in increased incorporation of Cu^{64} . With functioning enzyme the amount of Cu^{64} incorporated is dependent in part on the amount of substrate oxidized and on the concentration of Cu^{64} . In the case of both resting and functioning enzyme it has been observed that the amount of radiocopper incorporated under any fixed set of conditions depends on the nature of the enzyme as measured by its activity per microgram of copper. This latter dependence has been interpreted as arising from the presence of at least two different types of copper sites in the enzyme - active and inactive. It appears that the enzymatically inactive copper, although non-dialyzable, is the more loosely bound and exchanges more readily than the active copper.

The possible interactions between the components of the exchange systems - enzyme, ascorbic acid, and cupric ion - are discussed. It has been concluded that in such systems the free cupric ion plays no significant part in the oxidation of the ascorbic acid.

The relatively large amounts of enzyme required for the experiments with radiocopper were obtained by a new preparative method. This method is briefly described.

101 pages. \$1.50. Mic 56-2458

URINARY KETOSTEROID EXCRETION PATTERNS IN THE ADRENOGENITAL SYNDROME AND CUSHING'S SYNDROME

(Publication No. 17,136)

Minoru Masuda, Ph.D.
University of Washington, 1956

This study was an investigation into the urinary ketosteroid excretion pattern in 5 cases of adrenogenital syndrome due to adrenal hyperplasia and 2 patients with signs of Cushing's syndrome. From these urinary patterns, as compared to normals, an attempt was made to deduce the hormonal changes which had occurred in these cases of adrenocortical hyperfunction.

Experimental studies indicated that the following procedure for the treatment of urine would result in a ketosteroid spectrum which was a valid representation of these urinary metabolites. The urines were refluxed for 10 to 15 hours in order to liberate the 3β -hydroxyketosteroids. After ether extraction the residual urine was subjected to a β -glucuronidase hydrolysis at a pH of 5.0 at 37.5°C for 72 hours, a treatment which liberated the

ketosteroid glucuronides. After ether extraction, the residual urine was treated to a final hot acid hydrolysis in order to cleave difficultly hydrolyzable conjugates. The ether extracts from these 3 hydrolytic steps were washed with alkali and water. The β -glucuronidase and hot acid hydrolytic extracts were combined since the 2 processes release like steroids from their conjugates. The reflux hydrolysis extract was fractionated separately. Fractionation was accomplished by a modified alumina chromatographic procedure subsequent to a Girard ketonic purification. These chromatographic fractions were subjected to infrared analyses for steroid identification. Quantification of the individual ketosteroids identified were made on the basis of the Zimmerman color titer of the fractions.

The urinary ketosteroid excretion patterns in the adrenogenital syndrome (3 female pseudohermaphrodites and 2 boys diagnosed as macrogenitosomia praecox) revealed distinct increases in the following ketosteroids: androsterone, etiocholanolone, pregnanolone, 11-hydroxyandrosterone, 11-ketoetiocholanolone, 17-hydroxypregnanolone, and pregnanetriol. There was also a consistent absence of 11-hydroxyetiocholanolone.

In the 2 patients with Cushing's signs, the altered urinary ketosteroid excretion patterns were manifested as increased or normal excretion of etiocholanolone and increased excretions of 11-ketoetiocholanolone and 11-hydroxyetiocholanolone. There was a decreased excretion of androsterone.

Dehydroisoandrosterone excretion in all of these patients was variable.

Metabolic studies in humans after administration of known steroids have shown the relationship between urinary metabolites and their hormonal precursors. The above alterations in these syndromes are discussed with these relationships as the basis. In the adrenogenital syndrome, the altered excretory pattern is due to 1.) decreased hydrocortisone secretion by the adrenal cortex, 2.) increased secretion of C-19 androgenic steroids such as 4-androstenedione and 11 β -hydroxyandrostenedione, 3.) increased secretion of biosynthetic intermediates such as 17-hydroxyprogesterone and 21-desoxyhydrocortisone. It is concluded that the virilization seen in this syndrome is a consequence of multiple androgenic hypersecretions of steroids such as 4-androstenedione, 11 β -hydroxyandrostenedione, and 17-hydroxyprogesterone.

In Cushing's syndrome, the altered ketosteroid pattern is due to 1.) increased secretion of hydrocortisone and 2.) relatively reduced secretion of C-19 steroids. The excessive secretion of hydrocortisone leads to the production of the prominent characteristics in this syndrome and variability in the secretion of the androgenic C-19 steroids is reflected in the variability of virilization signs.

101 pages. \$1.50. Mic 56-2459

THE EFFECT OF HORMONES ON THE INTERMEDIARY METABOLISM OF MAMMARY GLANDS

(Publication No. 17,401)

Merrill Stafford Read, Ph.D.
The Ohio State University, 1956

The biochemistry of hormone action is becoming increasingly important. The mammary gland provides an

excellent tissue for the study of many hormonal mechanisms by virtue of its external position in the animal body and its high rate of synthetic activity. Prolactin, which initiates milk production by mammary tissue, further offers unique opportunities for the investigation of the biochemistry of action of the protein hormones.

In the study, guinea pig mammary tissue has been demonstrated to have rapidly increasing citric acid and Coenzyme A (CoA) concentrations during the first thirty-six hours post partum. These increases appear to parallel the pituitary prolactin content reported by other investigators.

The development of a surgical technique in which an animal served as its own control has been described. Following the surgical removal of one gland, prolactin injections were made into the remaining gland during the subsequent twenty-four hour period. The animal was then sacrificed and the second mammary gland removed. By means of this technique, demonstrable increases in CoA and citric acid contents were obtained in the hormone-treated gland. Lower values were obtained in tissues from similar saline-injected control animals. Shortening the period between surgery, plus prolactin injection and sacrifice, resulted in an even greater increase in CoA concentration as a consequence of hormone treatment.

Fresh mammary homogenates have been shown to have low levels of CoA synthesizing activity when pantetheine was used as the substrate. The presence of small amounts of phosphate ion was mandatory for this demonstration. Guinea pig mammary acetone powder extracts have been found to contain high concentration of CoA-synthesizing enzymes; these enzymes were activated by magnesium ions and inhibited by manganese ions. Prolactin had no effect on CoA synthesis by mammary acetone powder extracts.

The addition of fresh homogenate to mammary acetone powder extracts decreased the synthesis of CoA by the extracts. This decrease was reversed by the addition of prolactin.

Aqueous homogenates of mammary tissue have been shown to degrade CoA at a rapid rate at pH 8.0. The presence of fluoride ions or phosphate ions inhibited the degradative activity. A combination of pH 7.4 and phosphate ions completely inhibited mammary tissue CoA degradation. Prolactin also inhibited CoA degradation. Mammary homogenates did not degrade pantetheine when it was used as the sole substrate.

Although inhibition of CoA degradation by mammary homogenates was demonstrated by employing the Kaplan-Lipmann method of CoA assay, the application of a purified pigeon liver assay method did not indicate the inhibition in the same samples. The results have been interpreted as indicating the formation of a bound form of CoA which is not active in the purified system but is active in the Kaplan-Lipmann assay system. Presumably the complex contains prolactin. The possible structure and metabolic role of the proposed prolactin-CoA complex have been discussed.

These results explain, in part, the in vivo and in vitro results of prolactin administration observed by others.

154 pages. \$2.05. Mic 56-2460

PARTIALLY HYDROLYZED RIBONUCLEASE WITH ENZYMATIC ACTIVITY

(Publication No. 17,485)

William Irvine Rogers, Ph.D.
State University of Iowa, 1956

Chairman: Associate Professor George Kalnitsky

These studies were carried out to show that the whole protein is not needed for ribonuclease activity and to obtain an estimate of the size and chemical nature of the "active center" of the enzyme. After digesting ribonuclease with a carboxypeptidase preparation (without the addition of diisopropylfluorophosphate) an estimation of the amounts and kinds of amino acids liberated was made by paper chromatography. The seventeen amino acids known to be present in the ribonuclease molecule could be separated in three different solvent systems. It was found that at least one mole each of valine, leucine, phenylalanine, alanine, isoleucine, serine, threonine, histidine, aspartic acid and glutamic acid could be detected as products of the digestion without any loss of enzymatic activity. Neither cystine nor proline was detected in the digestion mixtures. No amino acids were found to be liberated from carboxypeptidase or ribonuclease alone. It was noticed in many experiments that an increased activity of 20% or more coincided with the digestion of 5-16% of the ribonuclease molecules, as measured by the liberation of valine (the C-terminal residue of ribonuclease). No explanation could be found for this phenomenon.

The spectrum of molecules ranging from undigested ribonuclease to those which had been digested up to the point of inactivation was found to have the same elution pattern from Amberlite IRC-50 (XE-64). It was concluded, therefore, that the elution pattern, under the conditions employed, was not a good criterion of the homogeneity of ribonuclease. That the overall charge on the enzymatically active molecules remained about the same, was suggested by this constancy of elution pattern and the fact that digested active molecules could not be separated from undigested ribonuclease by paper electrophoresis at a number of pH's.

After partial inactivation of the ribonuclease, by digestion with a carboxypeptidase preparation, there was a marked change in the elution pattern from IRC-50. Inactive protein was eluted before the main enzyme peak. The quantitative changes in elution pattern (measured by protein determinations) could be correlated with the per cent inactivation.

A paper chromatographic method was evolved for the separation of digested from undigested ribonuclease. The degree of separation was found to be proportional to the amount of valine liberated during digestion up to 0.5 moles of valine per mole of ribonuclease. Undigested and slightly digested ribonuclease were very stable under the conditions employed for chromatography and could be recovered quantitatively. Highly digested molecules, on the other hand, were not as stable. This chromatographic method is a convenient tool for separating digested ribonuclease molecules for further study.

Some peptides were found, by paper chromatography of the digestion mixtures, which migrated at the same rate as several amino acids. Without hydrolysis of the ninhydrin-positive spots, paper chromatography was not

sufficient to identify these amino acids.

It was found that one of the two moles of leucine, two of the three moles of isoleucine and three to four of the four moles of histidine could be liberated with about 70% of the ribonuclease activity remaining. From this data and the partial structural formula of oxidized ribonuclease it was estimated that as many as 40 to 50% of the residues of ribonuclease are not essential for the catalytic activity of the enzyme and therefore probably not a part of the "active center."

128 pages. \$1.70. Mic 56-2461

PRELIMINARY STUDIES ON THE SULFUR METABOLISM OF CHLORELLA PYRENOIDOSA WITH SULFUR-35

(Publication No. 17,271)

Jerome A. Schiff, Ph.D.
University of Pennsylvania, 1956

Supervisor: Dr. David R. Goddard

This paper is concerned with the sulfur metabolism of Chlorella pyrenoidosa Chick, in particular the incorporation of methionine- S^{35} and $S^{35}O_4^{=}$ into the soluble compounds within the cell. Methionine- S^{35} , although taken up by the cell, donates its labeled sulfur to other soluble compounds only very slowly. Sulfate- S^{35} , on the other hand, is incorporated into the soluble compounds very rapidly. One of the compounds formed in the incorporation of radioactive sulfate appears to be S-adenosyl methionine. The other compounds are as yet unidentified. Nutritional studies indicate that cystine and sulfate are equally good sulfur sources for Chlorella on a molar basis if initial growth rates are considered. Methionine is an inferior sulfur source and leads to the production of chlorotic cells.

Techniques have been developed to stabilize and control the process of sulfate reduction in Chlorella utilizing iodoacetamide as an inhibitor of the process. These techniques are described in detail. Possibilities for future lines of experimentation based on these techniques are also discussed.

68 pages. \$1.50. Mic 56-2462

STUDIES ON THE METABOLISM OF RIBOFLAVIN IN ASHBYA GOSSYPII

(Publication No. 17,557)

Robert Lawrence Stephens, Ph.D.
The University of Florida, 1956

Studies on the growth and riboflavin metabolism of Ashbya gossypii were undertaken to gain more facts pertaining to the mechanism of riboflavin synthesis in microorganisms, and thereby, bring about a more complete understanding of the pathway and intermediates participating in the synthesis.

Methods of circular and column chromatography were used and a method for the colorimetric estimation of riboflavin was developed and described.

The formation of riboflavin in a yeast extract-peptone medium was shown to occur almost entirely after the organism had reached maximum growth and was accompanied by a corresponding increase in the pH of the medium.

The chromatographic separation of peptone on a cellulose column, using a n-butanol-acetic acid-water (4:1:5) solvent, yielded a fraction which allowed good growth and riboflavin formation. The paper chromatographic analysis of a hydrolyzate of this fraction revealed that it contained mainly the dicarboxylic and basic amino acids.

Based on the results of the fractionation of peptone, a synthetic medium, containing glutamic acid, arginine, glucose, mineral salts and vitamins, was developed which allowed good growth of the organism but little or no riboflavin formation. The addition of glycine or leucine to this medium permitted the formation of riboflavin.

Experiments with yeast extract-peptone agar grown cells indicated that some factor or factors were present in the cells which stimulated the formation of riboflavin to a slight extent. Aqueous cell extracts of *A. gossypii*, obtained by grinding the cells in distilled water with ground glass and sand, were shown to stimulate riboflavin synthesis in a synthetic medium containing glycine. The stimulating factor or factors were present in aqueous extracts of 132 hour cells but could not be demonstrated in 84 hour cells. The chromatographic analysis of the cell extract on filter paper strips and subsequent tests of fractions indicated that the stimulating factor or factors did not migrate in the butanol-acetic acid-water solvent system.

The addition of relatively large concentrations of glutamic acid or asparagine to a peptone medium resulted in decreased formation of riboflavin and increased growth. Other results indicated also that in media where growth was decreased, the riboflavin yield usually increased.

The nitrogen sources NH_4NO_3 , KNO_3 , $(\text{NH}_4)_2\text{SO}_4$, ammonium acetate, ammonium citrate and urea would not support growth or riboflavin synthesis when tested as the only nitrogen source in the medium. Relatively high concentrations of nitrate ions in a peptone medium appeared to inhibit the formation of riboflavin.

In synthetic media with glutamic acid, aspartic acid or asparagine as the principal nitrogen source, the addition of glycine resulted in an increased formation of riboflavin, especially in the presence of aspartic acid or asparagine; however, replacement of glycine by equivalents of L-serine or DL-threonine resulted in little increase.

The presence of 40.0 mg. of L-histidine HCl per 100 ml. of medium produced an inhibiting effect on growth; however, the synthesis of riboflavin was not impaired to any extent. Imidazole was shown not to exert the inhibitory effect of histidine. The relationships of amino acids were studied in a histidine inhibited cell system and these relationships were discussed. The amino acids, cystine and methionine relieved the histidine inhibition and the amino acids, glycine, serine, threonine and leucine were shown to have the greatest stimulatory effect on riboflavin synthesis under these conditions.

The relationships of amino acids and other factors to growth and riboflavin formation in *A. gossypii* were discussed and suggestions for further work presented.

159 pages. \$2.10. Mic 56-2463

ISOLATION AND PROPERTIES OF YEAST ALDOLASE

(Publication No. 17,149)

Bernardo Sanchez Vanderheiden, Ph.D.
University of Washington, 1956

The method for the isolation and crystallization of yeast aldolase is described. The starting material consists of the extract obtained by toluene plasmolysis of the cells. The fractionation is carried out in its entirety by ammonium sulfate precipitation. The crystalline enzyme appears to be nearly homogeneous on electrophoresis in phosphate buffer 0.1 ionic strength, pH 7.2, and on ultracentrifugation in 0.1 M NaCl. The turnover number of the yeast enzyme was found to be approximately 1300 at 25° when the activity is measured by the chemical method of Sibley and Lehninger. The optimum pH of the enzyme was found to be 7.3 in .03 M phosphate buffer using the chemical method. The sedimentation constant of the enzyme was calculated to be 4.79 Svedberg units.

In contrast to muscle aldolase the enzyme from yeast is strongly inhibited by metal chelating agents particularly EDTA and o-phenanthroline, and by DPN and ATP. No heavy metals were detected in significant quantity in the supernatant solutions obtained after precipitation of the protein by TCA.

A two-fold increase in yeast aldolase activity is obtained in .03 M phosphate while the muscle enzyme is inhibited at this concentration. The K_m of the yeast enzyme was found to be 8.4×10^{-3} M/l in the absence of phosphate and 6×10^{-3} M/l in the presence of .03 M phosphate.

A mechanism is postulated to explain the phosphate activation. Furthermore the activation is interpreted as a possible factor contributing to the Pasteur effect.

98 pages. \$1.50. Mic 56-2464

CHEMISTRY, INORGANIC

THE STRUCTURES AND STABILITIES OF SOME COMPLEX INORGANIC COMPOUNDS:

- I. THE DETERMINATION OF WATER IN COMPLEX INORGANIC COMPOUNDS
- II. THE STRUCTURES OF SOME THIOCYANATO COBALT AMMINES

(Publication No. 18,120)

Mark Munroe Chamberlain, Ph.D.
University of Illinois, 1956

I. The Application of Karl Fischer Reagent to the Determination of Water in Inorganic Coordination Compounds

The purpose of this investigation was to determine the applicability of Karl Fischer reagent to the differentiation of coordinated and uncoordinated water in complex inorganic compounds.

The Karl Fischer reagent (1), a mixture of pyridine, methanol, sulfur dioxide, and water, has been widely used to determine quantitatively the water content of organic and inorganic materials. Only one report has been made (2) concerning the use of this reagent in determining water in coordination compounds, and the authors state that for un-

known reasons their titrations of various aquo-hydroxy-cobalt ammines gave low, variable results.

Using a Beckman KF-1 aquameter, twenty inorganic coordination compounds containing either coordinated water or lattice water or both were titrated in methanol solution until an endpoint stable for thirty seconds was reached. It was hoped that this endpoint would represent the complete titration of lattice water. After the initial endpoint, enough additional reagent was added at one minute intervals to return the system to a thirty second endpoint. From a plot of time vs. total volume of reagent, the second endpoint, supposedly representing complete titration of all water present, was determined graphically.

It was found that in solution chromium and nickel complexes, all the water present had been titrated at the second endpoint but that the initial endpoint was not significant. No differentiation of lattice and coordinated water could be made. Cobalt complexes, not stabilized by chelation, gave low, variable results, probably due to the reduction of cobalt (III) to cobalt (II) in nonstoichiometric quantities (3).

II. The Structure and Stability of Some Thiocyanato Cobalt Ammines

The purpose of this investigation was to study the role of thiocyanate ion as a coordinating group. Using infrared spectroscopy and potentiometric titrations as tools, it was hoped that information concerning the bonding between thiocyanate and the metal and that within the thiocyanato group would be obtained. Also, two divergent views (4) (5) have been published concerning the stability of the silver addition products of the thiocyanato cobalt ammines. It was hoped to resolve these views during this study.

The chloride, thiocyanate, and perchlorate salts of $[\text{Co}(\text{NH}_3)_5\text{NCS}]^{++}$, *cis* and *trans*- $[\text{Coen}_2(\text{NCS})\text{Cl}]^+$ and *cis* and *trans*- $[\text{Coen}_2(\text{NCS})_2]^+$ were prepared as well as simple heavy metal thiocyanates and compounds of the type represented by $\text{CoHg}(\text{SCN})_4$ in which thiocyanate has been shown to act as a bridge between the metals. The infrared spectra of these solid materials were obtained in mineral oil mull, and solutions of the perchlorate salts of the cobalt ammines were titrated potentiometrically with silver perchlorate.

From the results of these investigations, a resonance hybrid involving partial double bonds between cobalt and the nitrogen of the thiocyanato group has been postulated. This hybrid involves a partial triple bond between the carbon and nitrogen and a partial double bond between carbon and sulfur of the coordinated thiocyanato group, in agreement with the infrared evidence.

The potentiometric studies of the reaction between the thiocyanato cobalt ammine and silver ion indicate that no soluble stable addition product is formed in solution. The existence of solid materials containing a 1:1 ratio of complex to silver has been attributed to dipole attraction between the thiocyanato group or groups and the silver ion.

A study of the infrared spectra of the acido-bisethylenediamine cobalt (III) salts has shown that it is possible to differentiate between coordinated and ionic thiocyanate in these materials. From a comparison of the deuterated and undeuterated compounds, the frequencies peculiar to the N-H stretching deformation and wagging frequencies have been assigned.

BIBLIOGRAPHY

- (1) K. Fischer, *Z. Angew. Chem.* **48**, 394 (1935)
- (2) J. Mitchell and D. Smith, *Aquametry*, Interscience Publishers, Inc. N. Y. (1948) pg. 39
- (3) R. Yalman, *J. Am. Chem. Soc.* **75**, 1842 (1953)
- (4) A. Werner, *Ann.* **386**, 1 (1912)
- (5) W. C. Waggener, J. A. Mattern, and G. H. Cartledge, Abstracts of papers, 122nd National Meeting, American Chemical Society, September, 1952, pg. 19P

91 pages. \$1.50. Mic 56-2465

THE REMOVAL OF CARBON FROM FERRO-CHROMIUM

(Publication No. 17,103)

Arthur R. Corder, Ph.D.
Vanderbilt University, 1956

Supervisor: Professor W. P. Fishel

High-carbon ferro-chromium is not satisfactory for the preparation of higher chromium alloy steels, because a chromium carbide, Cr_{23}C_6 , is formed in the process. The formation of this carbide removes a large amount of chromium from the matrix near to the grain boundaries, and this impoverished area is then subject to corrosion.

Ferro-chromium containing 4.5% carbon and approximately 70% chromium was used in this study. The ferro-chromium was put into the molten condition by use of a custom built chromite crucible to hold the charge and a Tocco generator to supply the energy necessary to operate the small induction furnace.

Compounds such as chromic oxide, magnetic iron oxide, ferric oxide, silicon dioxide, and the mineral chromite were added to the molten ferro-chromium. These compounds furnished a supply of oxygen which united with the carbon in the ferro-chromium. The products of the reaction were a mixture of carbon monoxide and carbon dioxide gas, and the metal constituent obtained from the oxidizing agent.

It was determined that chromic oxide was the best oxidizing agent among those mentioned above, but that some silicon dioxide had to be added to the melt to keep the slag fluid, and to keep it from forming a heavy slag ridge in the crucible. The carbon content of the ferro-chromium was reduced from 4.5% to about 1% during a melting period of 45 minutes and by addition of 12% chromic oxide and 5% silicon dioxide by weight to 350 grams of high-carbon ferro-chromium. The chromium content remained about the same throughout the process.

By keeping the ferro-chromium in the molten condition for 30 minutes, and the surface of the molten metal exposed to the air, it was possible to remove a small amount of the carbon in the ferro-chromium. Magnetic iron oxide and silicon dioxide were found to aid in the removal of carbon also, but not to any great extent. Chromite had little effect as an oxidizing agent in this reaction.

Three carbides of chromium, Cr_{23}C_6 , Cr_7C_3 , and Cr_3C_2 , were possible compounds which chromium might form with carbon in ferro-chromium. The carbon in these alloys was

completely in the combined state as both iron and chromium are quite avid carbide formers. According to the phase diagram for the iron-chromium-carbon system at 70% chromium and 1-4.5% carbon, the carbide present in the alloys made in this study was Cr_{23}C_6 . To show that this was so, the alloys produced were studied microscopically, and a eutectic formed by a chromium carbide and a solid solution of iron and chromium was found in all the alloys. The amount of eutectic present decreased with decrease in carbon content of the alloy. Photomicrographs were made of the polished and etched alloys.

Samples of the alloys were dissolved in dilute HCl (1:8) to separate the chromium carbides which are practically insoluble in hot dilute HCl. The carbide residues were analysed for carbon, and X-ray diffraction patterns were made on the residues. The results of these experiments showed the presence of Cr_{23}C_6 in the carbide residue.

This study has shown that carbon can be removed from high-carbon ferro-chromium by use of the electric induction furnace, and although it was not the purpose of the study to determine whether or not all the carbon could be removed, the conclusion might be drawn from the results of this study that the carbon content could be lowered to 0.1% or less.

65 pages. \$1.50. Mic 56-2466

THE KINETICS OF THE FERRICYANIDE-FERROCYANIDE EXCHANGE REACTION

(Publication No. 17,182)

Charles Francis Deck, Ph.D.
Washington University, 1956

Chairman: Arthur C. Wahl

The object of the thesis research was the determination of the kinetics of the exchange reaction between ferricyanide and ferrocyanide ions. This study was carried out using the method of radioactive tagging of one of the reactants. The radioisotope of iron used was Fe^{55} .

The results of the research are as follows:

The rate of the ferricyanide-ferrocyanide exchange has been found to be first order in each of the reactants in alkaline solution, the second-order rate constant being $356 \text{ F}^{-1} \text{ sec}^{-1}$ in $1.05 \times 10^{-2} \text{ F KOH}$. The activation energy was found to be $4.6 \pm .3 \text{ kcal mole}$ at this KOH concentration.

A large but unspecified dependence on hydrogen ion concentration was observed.

The rate of the exchange exhibited a strong dependence on potassium hydroxide concentration. Substitution of other univalent anions for a large fraction of the hydroxide ion at constant potassium ion concentration did not affect the rate. Consideration of these effects suggests that the activated complex contains a potassium ion.

A treatment of the data in the light of the barrier penetration theory of Marcus, Zwolinski, and Eyring yielded results consistent with the theory.

59 pages. \$1.50. Mic 56-2467

A STUDY OF COLOR REACTIONS IN NON-AQUEOUS MEDIA

(Publication No. 17,439)

McGee A. Duff, Ph.D.
Louisiana State University, 1956

Supervisor: Boyd Professor Philip W. West

A study of some color reactions in non-aqueous solvents has been made. The major part of the study was concerned with the preparation and reactions of some substituted amides of thioglycolic acid. Compounds of this type show promise for use as analytical reagents. The effect of substitution of nitro groups into N-(phenyl)-mercaptoethanamide was determined and discussed. It was shown that N-(3-nitrophenyl)-mercaptoethanamide might serve very well as a qualitative reagent for cobalt.

It was found that mercury (I) and (II) can be extracted into *n*-butyl acetate from solutions containing trichloroacetic acid. This may be used to advantage for the detection of small amounts of mercury.

55 pages. \$1.50. Mic 56-2468

CORRELATION OF COMPOSITION AND STRUCTURE OF SOME PEROVSKITE-LIKE COMPOUNDS OF TRANSITION METALS

(Publication No. 18,325)

Beatrice Eleanor Gushee, Ph.D.
The University of Connecticut, 1956

A survey has been made of the extent to which the perovskite-structure occurs among ternary oxides of the type ABO_3 , where A is lanthanum or an alkaline earth metal, and B is a fourth period transition metal.

New perovskite-like or modified perovskite-like phases and/or new structural data were obtained in the following systems: lanthanum manganese oxide, lanthanum nickel oxide, barium vanadium oxide, barium manganese oxide, barium iron oxide, barium cobalt oxide, barium nickel oxide, strontium vanadium oxide, strontium chromium oxide, strontium manganese oxide, strontium iron oxide, strontium cobalt oxide, strontium nickel oxide, and calcium manganese oxide.

Chemical analyses indicate that oxygen deficiencies are common among these phases, so that the type-formula becomes ABO_{3-x} where x is less than one.

Single crystals of $\text{BaCoO}_{2.85}$ were grown and their structure determined by means of Weissenberg and powder x-ray techniques. The crystal characterization is:

Hexagonal system: $a = 5.58\text{\AA}$; $c = 4.78\text{\AA}$

Laué group: D_{6h}

Space group: $P6_3mc$, $P6_3/mmc$, $P6_2c$

Cell contents: Two formula weights

Density: 6.2 g cm^{-3}

131 pages. \$1.75. Mic 56-2469

TERNARY OXIDE PHASES OF THE GROUP IV TRANSITION METALS

(Publication No. 18,326)

Michael Kestigian, Ph.D.

The University of Connecticut, 1956

The main purpose of this thesis was to prepare ternary oxides containing group IV transition metals. Special emphasis was placed on the preparation of non-stoichiometric phases of these elements.

A study of the binary oxygen system of zirconium failed to reveal the presence of a lower oxide of zirconium. The various methods of reduction that were attempted failed or gave metallic zirconium.

In the ternary system, lanthanum-zirconium-oxygen, the phase $\text{La}_2\text{Zr}_2\text{O}_7$ was found to be exceptionally stable towards reducing agents and no method could be devised to prepare the product LaZrO_3 .

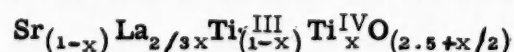
A series of cation defect phases were found in the lanthanum-titanium(III)-titanium(IV)-oxygen system. Homogeneous products were obtained when the appropriate oxides were heated in pellet form in evacuated sealed silica capsules at 1250°C for 48 hours. The range of composition of this phase which has the cubic perovskite structure was established to be from LaTiO_3 to $\text{La}_{0.70}\text{TiO}_3$. The lattice constants were observed as varying linearly with composition from 3.926 to $3.887 \pm 0.002\text{\AA}$ for the high titanium(III) to low titanium(III) content phases, respectively. Experiments that were performed to replace some or all of the titanium(III) by gallium and aluminum were unsuccessful in producing defect phases. Likewise, investigations in which some or all of the titanium(IV) content was replaced by zirconium were unsuccessful.

An anion defect phase of strontium and titanium(III) oxide was established to be $\text{SrTiO}_{2.5}$. Chemical analyses verify this composition, as did a density determination. Another piece of evidence which further substantiates this phase is the formation of a solid solution with SrTiO_3 having the formula $\text{SrTi}_{(1-x)}^{\text{III}}\text{Ti}_x^{\text{IV}}\text{O}_{(2.5+x/2)}$. If the phase were similar to the reported $\text{Sr}_{0.67}\text{V}_{0.33}\text{VO}_{2.67}$, the formula $\text{Sr}_{(0.75+x)}\text{Ti}_{(1.5-6x)}^{\text{III}}\text{Ti}_{4x}^{\text{IV}}\text{O}_3$ would govern the amounts of reactants needed to prepare the desired intermediate phases. This was found, by experiment, not to be the case.

The anion deficient phase $\text{SrTiO}_{2.5}$ was systematically filled by the addition of titanium(IV) oxide. The general formula: $\text{Sr}_{(1-x)}\text{M}_x^{\text{II}}\text{Ti}_{(1-x)}^{\text{III}}\text{Ti}_x^{\text{IV}}\text{O}_{(2.5+x/2)}$ where $\text{M}^{\text{II}} = \text{Sr, Ca, Ba}$ was found to exist for values of x from zero to one, inclusive. The variation of the cubic perovskite phases was observed as would be expected. A linear relationship of lattice constant versus composition was established.

The anion defect phase $\text{SrTiO}_{2.5}$ was found to form a complete solid solution with LaTiO_3 . The lattice constants were found to vary between the limits 3.903 and 3.926\AA .

Attempts to prepare an anion-cation defect phase in the same product were unsuccessful. The formula:



was used as a basis for this study.

The stoichiometric phases SrTiO_3 and LaTiO_3 were found to form a complete range of solid solution.

These results clearly established the existence of cation and anion deficiencies in ternary oxide systems of titanium.

91 pages. \$1.50. Mic 56-2470

THE REACTIONS OF CHLORAMINE WITH PRIMARY, SECONDARY, AND TERTIARY AMINES IN NON-AQUEOUS MEDIA

(Publication No. 17,399)

George Michael Omietanski, Ph.D.

The Ohio State University, 1956

Chloramine produced by the gas phase reaction of chlorine and ammonia will, in general, react with various anhydrous primary and secondary amines to form N-substituted hydrazines. It has been found that good yields of alkyl hydrazines are obtained in the absence of gelatin and permanent base. The reaction of chloramine with diethylamine yields mono ethylhydrazine.

It has been shown that chloramine also reacts with a variety of tertiary amines to form the corresponding 1,1,1-trisubstituted hydrazinium chlorides in good yield. However, when the tertiary nitrogen is part of an aromatic ring, as in pyridine, the corresponding N-amino compounds are not obtained. A series of 1,1,1-trisubstituted hydrazinium hexafluorophosphates have been prepared. The reaction of chloramine with tertiary amines has not previously been reported.

The results obtained from the chloramine-amine reactions have been discussed in terms of reaction mechanism and of their implications with respect to the chloramine-ammonia reaction.

78 pages. \$1.50. Mic 56-2471

SOME CHEMICAL PROPERTIES OF TRIFLUOROMETHYL HYPOFLUORITE

(Publication No. 17,141)

Roger Stephen Porter, Ph.D.

University of Washington, 1956

Trifluoromethyl hypofluorite was prepared in quantity by the reaction of carbon monoxide with excess fluorine. The crude product was easily purified, and then stored as a gas in a steel cylinder. By studying the behavior of trifluoromethyl hypofluorite with stopcock greases, metals, and glass, suitable techniques were devised for performing reactions of the gas.

The thermal dissociation of trifluoromethyl hypofluorite was carefully studied between 640°K and 740°K in a fluorinated nickel vessel. In this temperature range the equilibrium, $\text{CF}_3\text{OF} = \text{COF}_2 + \text{F}_2$, was quickly attained, fluorine did not attack the reactor, and the equilibrium constants were measurable. The molar heat of dissociation at 700°K is 27.7 Kcal. , and by utilizing available thermodynamic values for fluorine and carbonyl fluoride, calculations were made at several temperatures for the changes in free energy, heat content, and entropy accompanying the dissociation reaction. Molar values for the free energy, entropy, and heat of formation of trifluoromethyl hypofluorite were also derived.

The metals, mercury and lithium, were fluorinated by trifluoromethyl hypofluorite at room temperature, but a resistant nickel surface was attacked only above 740°K , where fluorine was the active agent. Sulfur was readily fluorinated to sulfur tetrafluoride by trifluoromethyl hypofluorite, and concomitantly gave carbonyl fluoride as the hypofluorite reduction product. With lithium carbonate,

trifluoromethyl hypofluorite reacted at room temperature to form lithium fluoride, carbon dioxide, and oxygen.

Reaction with tetrafluoroethylene was brought about under two sets of conditions. One reaction formed carbon monoxide and tetrafluoromethane, and the other produced polymeric tetrafluoroethylene compounds. On reaction with perfluorocyclopentene, trifluoromethyl hypofluorite added across the C=C bond at 80°C to form the previously unreported perfluoro[methoxycyclopentane]. The more important physical constants were obtained from the purified product. Trifluoromethyl hypofluorite was also added across the carbonyl double bond in carbonyl fluoride. Thus mixtures of CF_3OF and COF_2 , when heated to 250°C in a fluorinated nickel system, gave the first direct synthesis of the stable perfluoroperoxide, CF_3OOCF_3 .

A cold-glow discharge activated trifluoromethyl hypofluorite sufficiently for it to attack glass. However, in a fluorinated metal system, an electric spark in trifluoromethyl hypofluorite caused partial reversion of CF_3OF to carbonyl fluoride and fluorine, and in part, reaction to give tetrafluoromethane, oxygen, and carbon dioxide.

135 pages. \$1.80. Mic 56-2472

COMPLEX FORMATION OF METAL IONS WITH CONGENERS OF IMINODIACETIC ACID

(Publication No. 17,492)

Robert Myron Tichane, Ph.D.
State University of Iowa, 1956

Chairman: Professor William E. Bennett

In this dissertation, the formation of chelates of the divalent ions of copper, nickel, cobalt, zinc, calcium, and magnesium with congeners of iminodiacetic acid were investigated. The acids which were used were: N,N-hydrazinediacetic acid, N-nitroiminodiacetic acid, N-nitrosoiminodiacetic acid, N-phenyliminodiacetic acid, N-(o-tolyl)iminodiacetic acid, diglycolic acid, thiodiglycolic acid, 2,6-pyridinedicarboxylic acid, and 2,6-piperidinedicarboxylic acid.

The first and second dissociation constants of the acids were determined by algebraic treatment of the results of pH titrations of the acids with potassium hydroxide.

The first and second formation constants for the chelates were determined by using the pH method and spectrophotometric method of analysis, and algebraic treatment of the data.

The average of the negative logarithms of the first and second acid dissociation constants were found to be related linearly with the first formation constant of each metal ion as it chelated with those acids, with the exception of pyridinedicarboxylic acid and piperidinedicarboxylic acid.

The reason advanced for the nonconformity of these two acids was that steric factors became important in chelate formation with these acids.

The electron-withdrawing nature of the N-substituent on iminodiacetic acid was found to be correlated with the complex-forming tendency of the acid.

When sulfur and oxygen were substituted for the NH group of iminodiacetic acid, it was found that the sulfur acid was more effective as a chelating agent than the oxygen acid except in the case of chelates of calcium.

81 pages. \$1.50. Mic 56-2473

CHEMISTRY, ORGANIC

THE PREPARATION AND PROPERTIES OF VINYL AND GLYCIDYL FLUOROETHERS

(Publication No. 17,544)

Mary Louise Van Natta Brey, Ph.D.
The University of Florida, 1956

Vinyl fluoroethers were prepared by a three-step procedure: (1) synthesis of a β -hydroxyethyl fluoroether, (2) replacement of the hydroxyl group with chlorine through use of phosphorus pentachloride, and (3) dehydrochlorination of the β -chloroethyl ether by treatment with alcoholic potassium hydroxide.

Two types of β -hydroxyethyl fluoroethers were prepared: those having fluorine present in the α position of the alkyl group, by the base-catalyzed addition of ethylene glycol to 1,1-difluoroolefins; and those with fluorine substituted in the β position, by the addition, in basic medium, of fluoroalcohols to ethylene oxide. The new ethers prepared by the first method were

$\text{CH}_2\text{OHCO}_2\text{OCF}_2\text{CHCl}_2$ and $\text{CH}_2\text{OHCH}_2\text{OCF}_2\text{CHFCl}$. The new β -fluoroethers which were synthesized were $\text{CH}_2\text{OHCH}_2\text{OCH}_2\text{CF}_3$, $\text{CH}_2\text{OHCH}_2\text{OCH}_2\text{C}_2\text{F}_5$, $\text{CH}_2\text{OHCH}_2\text{OCH}_2\text{C}_3\text{F}_7$, and $\text{CH}_2\text{OHCH}_2\text{OC}(\text{CH}_3)_2\text{CF}_3$.

Treatment of the above ethers with phosphorus pentachloride resulted in formation of the corresponding β -chloroethyl ethers in yields of about 20-50%.

By means of the dehydrochlorination reaction, $\text{CH}_2=\text{CHOCH}_2\text{CF}_3$, $\text{CH}_2=\text{CHOCH}_2\text{C}_2\text{F}_5$, and $\text{CH}_2=\text{CHOCH}_2\text{C}_3\text{F}_7$ were prepared in low yields. Only the last-named vinyl ether is a new compound; however the physical constants of only $\text{CH}_2=\text{CHOCH}_2\text{CF}_3$ are present in the literature. No method of preparation of these vinyl β -fluoroethers has been reported, nor have their infrared spectra been available.

Attempts to prepare vinyl ethers from the chloroethers having fluorine present in the α position, $\text{CH}_2\text{ClCH}_2\text{OCF}_2\text{CHCl}_2$ and $\text{CH}_2\text{ClCH}_2\text{OCF}_2\text{CHFCl}$, were unsuccessful. However, a known vinyl ether, $\text{CH}_2=\text{CHOCH}_2\text{CHFCl}$, was prepared by this procedure.

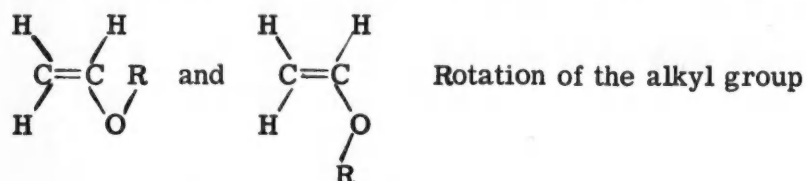
A method of preparing glycidyl fluoroethers in one step by the reaction of an α,α -dihydroperfluoroalcohol with epichlorohydrin and an equivalent amount of base was developed. The reaction is analogous to the addition of phenol to epichlorohydrin. The effectiveness of a basic catalyst was attributed to the relative acidity of the fluoroalcohols as compared with unsubstituted alcohols. Yields of glycidyl ethers were rather low when prepared by this procedure because of their further reaction with alcohol to form diethers. Three new glycidyl ethers were prepared: (1) $\text{CH}_2\text{CHCH}_2\text{OCH}_2\text{CF}_3$, (2) $\text{CH}_2\text{CHCH}_2\text{OCH}_2\text{C}_2\text{F}_5$, and

(3) $\text{CH}_2\text{CHCH}_2\text{OCH}_2\text{C}_3\text{F}_7$. Diethers of (1) and (3) were

isolated. The tertiary fluoroalcohol, $\text{CF}_3\text{C}(\text{CH}_3)_2\text{OH}$, gave none of the glycidyl ether when treated with epichlorohydrin by the same procedure.

The infrared spectra of vinyl and glycidyl fluoroethers are presented, and assignments of bands characteristic of the functional groups are discussed.

Two lines of confirmatory evidence are given for the existence of vinyl ethers in two isomeric forms:



about the carbon-oxygen bond is hindered as a result of the contribution of the resonance structure, $\text{CH}_2=\text{CH}=\text{O}^+-\text{R}$. The carbon-carbon double bond absorption, always presenting at least two bands near 6.10, 6.20 microns in the spectra of unsubstituted vinyl alkyl ethers, is replaced by a single band at 6.05 microns in the spectrum of $\text{CH}_2=\text{CHOCH}_2\text{CF}_2\text{CHCl}$. Thus the strong inductive effect of the alpha fluorine atoms prevents any conjugation of the unshared pair of oxygen electrons with the double bond. Fluorine substitution in the beta position, as in $\text{CH}_2=\text{CHOCH}_2\text{CF}_3$, does not prevent conjugation, for the usual doublet occurs, shifted to slightly lower wave lengths, in vinyl ethers of this type. The relative intensities of the double bond bands were found to be dependent upon temperature; this can only be explained by the existence of rotational isomers. The 6.20 micron band is attributed to the lower-energy form and the 6.10 micron band to the isomer of higher energy.

107 pages. \$1.50. Mic 56-2474

**PART A: THE PYROLYSIS OF 9-ARYLIDENE-
AND 9-ALKYLIDENEFUORENES AND
PART B: THE ACID CATALYZED REACTION OF
9-FUORENOL WITH 9-ALKYLIDENEFUORENES**

(Publication No. 17,468)

Edward James Dufek, Ph.D.
State University of Iowa, 1956

Chairman: Professor Stanley Wawzonek

The Pyrolysis of 9-Arylidene- and
9-Alkylidenefluorenes
by S. Wawzonek; E. Dufek;¹ and N. M. Sial.¹

The pyrolysis of 9-arylidene- and 9-alkylidenefluorenes formed fluorene and the corresponding toluene as the main products. A phenanthrene was formed only in the case of 9-benzylidenefluorene. 9-Alkylidenefluorenes upon similar treatment gave fluorene, 9-methylfluorene, and the corresponding 9-alkylfluorene.

The Acid Catalyzed Reaction of 9-Fluorenol
with 9-Alkylidenefluorenes
by S. Wawzonek, and E. Dufek.²

The addition of Grignard reagents to fluorenone in benzene and ether formed, in addition to the desired carbinols, considerable amounts of 9-fluorenol. These mixtures, if not separated, gave on hydration with acid 10-alkyl-10-(9'-fluorenyl)dibenzofulvenes in addition to the 9-alkylidenefluorenes. The structure of the former was demonstrated by reduction to the alkyl-bis-9-fluorenylmethanes, oxidation to fluorenone and the alkyl 9-fluorenyl ketone, and synthesis from 9-fluorenylmagnesium bromide and ethyl ester.

1. Abstracted in part from the Ph.D. Thesis (1956) of E. Dufek and the M.S. Thesis (1948) of N. M. Sial.

2. Abstracted in part from the Ph.D. Thesis; June, 1956, of E. Dufek and presented before the Organic Division of the American Chemical Society at the Cincinnati Meeting, April, 1955.

147 pages. \$1.95. Mic 56-2475

**CATALYSIS IN THE HYDRAZINOLYSIS
OF ETHYL ACETATE
A DETERMINATION OF THE VELOCITY
CONSTANTS, ENERGIES OF ACTIVATION AND
ENTROPIES OF ACTIVATION FOR THE REACTION**

(Publication No. 17,225)

Richard A. Ferren, Ph.D.
University of Pennsylvania, 1956

Supervisors: Allan R. Day and John G. Miller

The catalytic effect of alcohols on the reaction of hydrazine with ethyl acetate has been studied in an attempt to evaluate the behavior of alcohols in the type of reaction. The alcohols studied were simple aliphatic alcohols, ethylene glycol and propylene glycol.

The studies were carried out in both aqueous and anhydrous media. The diluent in all aqueous solutions was dioxane, while in the anhydrous solutions two different diluents were employed in order to determine the role of the diluent. The diluents used in the anhydrous medium were benzene and cyclohexane.

The results were interpreted on the basis of the velocity constants, energies and entropies of activation for the reaction. The kinetic energies of the alcoholic solutions varied and consequently entropy or steric considerations played a role in the determination of the catalytic activity. The tertiary alcohols had the largest negative entropies of activation and for the alcohols the kinetic energy factors may be generalized as: tertiary > secondary > primary. Chiefly for the above reason, the catalytic effect of the alcohols was primary > secondary > tertiary, since the difference in the energies of activation was slight.

As the molecular weight of the primary alcohols increased the rate of reaction also increased. Several intermediates were formulated which would explain this behavior. Also analyzed was the effect the diluent might be playing in the greater activity exhibited by the higher molecular weight primary alcohols. The presence of the diluent in much larger concentrations in the solutions where the lower molecular alcohols were encountered prompted this investigation.

73 pages. \$1.50. Mic 56-2476

NUCLEAR SUBSTITUTED ANALOGS OF
PHARMACODYNAMICALLY ACTIVE
PHENETHYLAMINES AND ISOQUINOLINE

(Publication No. 17,607)

Richard Dominic Foggio, Ph.D.
University of Virginia, 1956

The purpose of this investigation was to prepare nuclear substituted analogs of some pharmacodynamically interesting derivatives of phenethylamines and isoquinoline. The substituents introduced were the methyl group and the chlorine atom.

A survey of the effect of nuclear substituents on biologically active compounds is presented. Also, due to the resemblance of some of the compounds prepared to the hallucinatory agent mescaline, a review is given of certain hallucinogens.

The methyl group and the chlorine atom were compared with respect to size in order to evaluate their effect on a molecule. By constructing models of the two, their volumes, that is, the amount of space taken up by each, were calculated and found to be approximately equal.

The synthesis of the 2-methyl- and 2-chloro-3,4-dihydroxyphenethyl- and -phenylisopropylamines started with the 2-methyl- and 2-chloro-3,4-dimethoxybenzaldehyde, respectively. The latter compounds, obtained by means of a Sommelet reaction from the corresponding chloromethyl derivatives, were condensed with both nitromethane and nitroethane. The resulting nitrostyrenes and nitropropenes were reduced by lithium aluminum hydride to the saturated amines, which were demethylated by 48% hydrobromic acid to the dihydroxy compounds.

In an attempt to prepare 2-methyl-3,4-dihydroxybenzaldehyde, the dimethoxy aldehyde was treated with strong acid, but only a monohydroxy product was obtained. This was shown to be 2-methyl-3-hydroxy-4-methoxybenzaldehyde by conversion to the known 2-methyl-3-ethoxy-4-methoxybenzoic acid. Comparison of the monohydroxy compound with vanillin and isovanillin by means of their ultraviolet absorption spectra failed to contribute to the elucidation of its structure. A discussion of ether cleavage by strong acids is presented.

Experiments were made to prepare 1-substituted-5-methyl isoquinolines. By reacting 2-methyl-3,4-dimethoxyphenethylamines, in turn, with isobutyryl, diphenylacetyl and 3,4-dimethoxyphenylacetyl chloride, the corresponding amides were obtained. Employing the Bischler-Napieralski method of ring closure, the amides were treated with phosphorus oxychloride. Thus, 2-methyl-3,4-dimethoxyphenethyl-N-isobutyramide was cyclized to 1-isopropyl-5-methyl-6,7-dimethoxy-3,4-dihydroisoquinoline which was reduced to 1-isopropyl-5-methyl-6,7-dimethoxy-1,2,3,4-tetrahydroisoquinoline with lithium aluminum hydride. This dimethoxy compound could not be demethylated to the dihydroxy derivative. Treatment of 2-methyl-3,4-dimethoxyphenethyl-N-diphenylacetamide with phosphorus oxychloride yielded a product, apparently 1-keto-5-methyl-6,7-dimethoxy-1,2,3,4-tetrahydroisoquinoline. An interpretation of this reaction is offered. When 2-methyl-3,4-dimethoxyphenethyl-N-3,4-dimethoxyphenylacetamide was subjected to similar conditions for ring closure, an oxidized product was obtained, namely, 1-(3,4-dimethoxybenzoyl)-5-methyl-6,7-dimethoxy-3,4-dihydroisoquinoline. This was further dehydro-

genated to 1-(3,4-dimethoxybenzoyl)-5-methyl-6,7-dimethoxyisoquinoline.

Nuclear substituted amino ketones were prepared by reacting 2-methyl-3,4-dimethoxyphenacyl chloride and iodide with piperidine and morpholine, respectively. The amino ketones were demethylated to 2-methyl-3,4-dihydroxy- piperidino- and morpholinoacetophenone. The former compound was reduced to 1-(2-methyl-3,4-dihydroxyphenyl)-2-piperidinoethanol.

112 pages. \$1.50. Mic 56-2477

THE ACYLOIN REACTION OF ESTERS
OF DIBASIC ALIPHATIC ACIDS
IN LIQUID AMMONIA

(Publication No. 17,227)

George Foster, Ph.D.
University of Pennsylvania, 1956

Supervisor: Dr. A. L. McCloskey

This work was undertaken to determine the utility of using the reaction of esters of dibasic aliphatic acids with sodium in liquid ammonia to prepare cyclic acyloins. A method was developed for the preparation of acyloins from the methyl esters of adipic and glutaric acids in fair yield and from the methyl esters of β,β -dimethyl-glutaric and cyclohexane-1, 1-diacetic acids in high yields. The method consists of the slow addition of the ester dissolved in ether to a solution of sodium in liquid ammonia followed by the complete removal of the ammonia, rapid acidification of the residual salts with cold aqueous sulfuric acid and extraction of the acyloins with ethyl acetate.

It was concluded that liquid ammonia provides a useful and convenient solvent for the reductive cyclization of esters of dibasic acids with sodium particularly if the acid moiety has alkyl substituents. A possible ionic mechanism is suggested for the reaction.

60 pages. \$1.50. Mic 56-2478

THE EFFECT OF SUBSTITUENTS ON
THE 4-POSITION ON THE STABILITY OF
1-AMINO-2-METHYLNAPHTHALENE DERIVATIVES

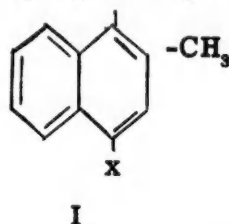
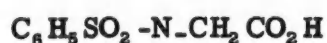
(Publication No. 18,138)

Hugh Harper Gibbs, Ph.D.
University of Illinois, 1956

INTRODUCTION

Restriction of the normal rotation of the carbon-nitrogen single bond has been the subject of numerous investigations. One aspect of this problem of considerable interest has been the influence of different substituents on the position para to the site of restricted rotation on the optical-stability of such compounds when the groups on the nitrogen and in the positions ortho to it have been the same from compound to compound. Comparison of the rates of racemization of the optically active forms of such molecules affords a means of determining the presence and character of factors other than strictly steric ones which

may influence stability. Derivatives of 1-amino-2-methylnaphthalene (I) in which the substituent x in the 4-position can be varied



offer an ideal system in which such effects can be studied.

Previous workers (1,2) have investigated compounds where x = nitro, chloro, bromo, iodo, hydrogen, benzene-sulfonamido, acetamido, benzamido, hydroxyl and amino. It was the purpose of this investigation to extend this series to include x = cyano, carboxamido, phenylmercapto, phenylsulfonyl, methyl and methoxyl.

DISCUSSION OF RESULTS

Six compounds, one of which has been previously described (1,2), were synthesized and resolved. The half-lives of optical activity in dimethylformamide solution at the temperature of boiling n-butanol were found to be dependent on the various 4-substituents as follows: cyano, sixty-two hundredths hour; phenylmercapto, one and seven-tenths hours; phenylsulfonyl, one and nine-tenths hours; hydrogen, four and six-tenths hours; methyl, five and four-tenths hours; methoxyl, eight hours. The carboxamido compound could not be resolved under the conditions tried.

The differences in the half-lives have been explained by the assumption that racemization proceeds via a planar symmetrical transition state which may be more or less resonance stabilized. Attainment of this resonance form involves passage of the lone pair of electrons on the nitrogen into the ring. Strong electron withdrawing substituents in the 4-position facilitate formation of this resonance form and so increase the rate of racemization. Conversely, electron donating substituents inhibit formation of this structure and so decrease the rate of racemization. Experimental observations are in agreement with this hypothesis. Strong electron withdrawing groups such as cyano and phenylsulfonyl greatly increase the rate of racemization whereas a strong electron donor such as the methoxyl group significantly retards racemization.

A new method for the preparation of aromatic phenylmercapto compounds has been found. This involved the reaction of cuprous thiophenolate with the aromatic bromide.

BIBLIOGRAPHY

1. R. Adams and R. H. Mattson, *J. Am. Chem. Soc.*, **76**, 4925 (1954).
2. R. Adams and K. V. Y. Sundstrom, *ibid.*, **76**, 5474 (1954). 142 pages. \$1.90. Mic 56-2479

THEORETICAL STUDIES ON THE CHEMISTRY OF QUATERNARY AMMONIUM COMPOUNDS

(Publication No. 17,550)

Betty Sue Gray, Ph.D.
The University of Florida, 1956

Stereochemical methods were employed in an attempt to shed light on the mechanism of amine exchange reactions between quaternary ammonium salts and primary and secondary amines.

The specific reaction studied was that between d-(+)-N,N,N-trimethyl- α -phenylethylammonium bromide and di-n-butylamine. Since physical constants for N,N,N-trimethyl- α -phenylethylammonium bromide were not found in the literature, the dl- and d-(+)- salts were prepared by means of the reaction of methyl bromide with the corresponding N,N-dimethyl- α -phenylethylamine. They were identified by the bromide content, which was determined by the Volhard method.

One of the products formed in the reaction studied was N,N-di-n-butyl- α -phenylethylamine. This previously unreported compound was prepared by two other methods and was characterized for use in identification of the product of the reaction studied. In addition, the dextro-rotatory form was obtained from the resolution of the inactive amine by the use of d-tartaric acid and its specific rotation was determined. Preparation of 1-(-)-N,N-di-n-butyl- α -phenylethylamine from 1-(-)- α -phenylethylamine by a method which should not have disturbed the carbon-nitrogen bond, served as a means of correlating configuration with direction of rotation.

In addition, α -phenylethylbromide and both optically active and inactive forms of N,N-dimethyl- α -phenylethylamine, which had been reported previously, were prepared by methods which varied slightly from those recorded in the literature. 64 pages. \$1.50. Mic 56-2480

SYNTHESIS OF GLUCOSE PHOSPHONATE DERIVATIVES

(Publication No. 17,609)

Beverly Smith Griffin, Ph.D.
University of Virginia, 1956

This investigation has been concerned with the synthesis of glucose phosphonic acid derivatives of interest for testing as potential competitive inhibitors of glucose 6-phosphoric acid in the glycolytic cycle.

A review of the chemistry of ω -deoxyhalo aldoses has been presented. The important preparative methods and reactions, classified as reductions, intermolecular, and intramolecular displacements, are included.

A number of acetylated dialkyl and diaryl glucose and glucoside phosphonate derivatives have been prepared utilizing the Michaelis-Arbuzov reaction as a synthetic method. It has been demonstrated that 6-deoxyhalo and 6-deoxytolylsulfonyl derivatives of glucose are reactive toward both trialkyl and alkyl diaryl phosphites in this reaction. For example, 1,2,3,4-tetra-O-acetyl- β -D-glucopyranose 6-(diphenyl phosphonate) has been prepared by the reaction of diphenyl ethyl phosphite and 1,2,3,4-tetra-O-acetyl-6-bromo-6-deoxy- β -D-glucopyranose.

The corresponding diethyl phosphonate has been prepared by the reaction of triethyl phosphite and the bromodeoxy compound and the benzyl glucosides have been synthesized in an analogous manner by reaction of the phosphites with benzyl 2,3,4-tri-O-acetyl-6-bromo-6-deoxy- β -D-glucopyranoside. The preparation of diphenyl ethyl phosphite has been described.

Hydrogenolysis of the diaryl phosphonates has proven an effective route to the glucose phosphonic acids. For example, 1,2,3,4-tetra-O-acetyl- β -D-glucopyranose 6-deoxy-6-phosphonic acid has been produced by hydrogenolysis of the corresponding diphenyl phosphonate. Hydrogenolysis of the glucopyranoside phosphonate removed both the benzyl group and the phenyl groups of the phosphonate moiety to produce 2,3,4-tri-O-acetyl-D-glucopyranose 6-deoxy-6-phosphonic acid. Hydrolysis of the diethyl phosphonate produced D-glucopyranose 6-deoxy-6-(diethyl phosphonate). The attempted removal of the protecting acetyl groups of 1,2,3,4-tetra-O-acetyl- β -D-glucopyranose 6-deoxy-6-phosphonic acid by both acidic and basic reagents has been discussed and certain inherent difficulties in this procedure have been presented.

The attempted preparations of glucose 1-phosphonate derivatives by means of both the Nylen and Michaelis-Arbuzov reactions were unsuccessful. Glucose 6-deoxy-6-halo and alkyl and aryl sulfonyl derivatives have been shown to be unreactive in the Nylen reaction. A chromatographic method for the separation and purification of glucose phosphonates has been shown to be successful. Certain factors possibly responsible for the chemical inertness of the 6-deoxyhalo glucoses are presented and a possible explanation for this lack of reactivity is advanced.

108 pages. \$1.50. Mic 56-2481

**ortho-SUBSTITUTED DURYL PHENYL KETONES:
RING CLOSURE, METALATION, AND
HALOGEN-METAL INTERCONVERSION**

(Publication No. 18,155)

Paul Raymond Jones, Ph.D.
University of Illinois, 1956

The discovery that certain *ortho*-substituted mesityl, duryl, and tipyl phenyl ketones undergo ring closure in the presence of hydrazine prompted interest in the steric requirements for such intramolecular reactions. In order to gain insight into this unusual behavior, consideration was given to several other *ortho*-substituted duryl phenyl ketones that were likely candidates for a similar ring closure. The synthesis of some of these candidates was undertaken. *o*-duroylbenzamide either failed to react or was converted to *o*-duroylbenzonitrile when it was subjected to conditions for dehydration. The tendency of *o*-duroylbenzophenone to undergo reaction with hydrazine was shown to be extremely slight. In contrast, *o*-duroylbenzhydrazide, in the presence of benzenesulfonyl chloride, was readily converted to the ring closure product, even at a low temperature. Two candidates that could not be synthesized by any of several methods employed are *o*-duroylacetophenone and *o*-duroylbenzaldehyde.

o-Duroylbenzyl alcohol was prepared by a new method, which consisted of the treatment of phthalide with duryl-magnesium bromide. A similar reaction was carried out

in order to obtain *o*-mesitoylbenzyl alcohol. *o*-Duroylbenzyl bromide, prepared by the action of anhydrous hydrogen bromide on the corresponding alcohol, was used to study the ring closure reaction. In the presence of hydrazine, it was converted to a complex mixture of products.

It was shown that the metalation of duryl *o*-tolyl ketone, by means of *n*-butyllithium, occurs at the side chain of the tolyl function. The product, after carbonation, is *o*-duroylphenylacetic acid, whose structure was proved by an independent synthesis. *o*-Duroylbenzyl bromide was converted to the corresponding nitrile, which was hydrolyzed in two steps to *o*-duroylphenylacetic acid. The intermediate amide was prepared from the carbonation product as well.

When the conditions of the metalation reaction were modified, the coupling product, *o,o'*-diduroylbibenzyl, was formed. The structure of this diketone was confirmed by means of an independent synthesis from *o*-duroylbenzyl bromide and *n*-butyllithium. It is noteworthy that, in the latter reaction, no acid was formed after carbonation. In addition to the coupling product, only starting material was isolated. The formation of the coupling product serves to verify the point of attack of *n*-butyllithium on duryl *o*-tolyl ketone.

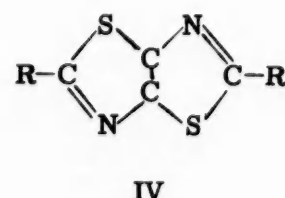
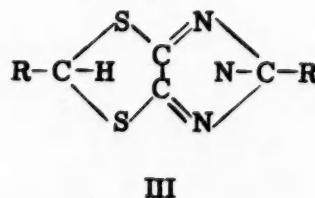
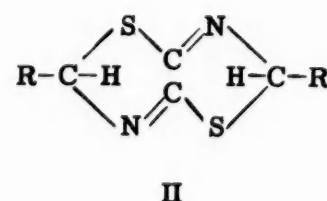
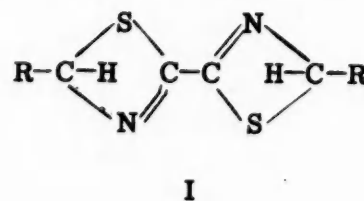
133 pages. \$1.80. Mic 56-2482

**THIAZOLOTHIAZOLES. THE REACTION OF
AROMATIC ALDEHYDES WITH DITHIOOXAMIDE**

(Publication No. 18,302)

Roger Gordon Ketcham, Ph.D.
Cornell University, 1956

The thermal condensation of dithiooxamide with aromatic aldehydes was first reported by Ephraim in 1891. A possible structure containing two four-membered rings (I) was proposed for the reaction product. Considerations of molecular geometry lead clearly to the view that this four-membered ring structure should be formed less readily than either of two isomeric structures containing two fused five-membered rings (II, III).



The symmetrical structure II is particularly interesting in that it should undergo dehydrogenation readily to afford the fully aromatic structure (IV).

Stepwise alkylation of the condensation product obtained from salicylaldehyde ($R = \text{O}-\text{HOC}_6\text{H}_4-$) established that the condensation product has a symmetrical structure. The

monomethyl monoethyl ether obtained by methylation followed by ethylation was identical with that prepared by alkylations effected in reverse order. The unsymmetrical structure (III) is thereby excluded since it would have furnished two different monomethyl monoethyl ethers.

Negative results in attempts to effect dehydrogenation, analytical data from many condensation products, nuclear magnetic resonance determinations, and ultraviolet spectra proved conclusively that the reaction products are derivatives of the aromatic structure (IV), that is, of 2,5-diarylthiazolo-[5,4-d]thiazole.

The reaction is limited to typical aromatic aldehydes. The yields obtained from dithiooxamide and several aromatic aldehydes are listed below. The reaction was unsuccessful with aliphatic aldehydes; aromatic ketones

Benzaldehyde	78%	<i>o</i> -chlorobenzaldehyde	17%
<i>o</i> -hydroxybenzaldehyde	37	<i>p</i> -chlorobenzaldehyde	43
<i>m</i> -hydroxybenzaldehyde	38	<i>o</i> -nitrobenzaldehyde	0
<i>p</i> -hydroxybenzaldehyde	29	<i>m</i> -nitrobenzaldehyde	54
<i>o</i> -methoxybenzaldehyde	47	<i>p</i> -nitrobenzaldehyde	59
<i>p</i> -methoxybenzaldehyde	64	cinnamaldehyde	14
<i>p</i> -bromobenzaldehyde	42	furfural	35

also failed to furnish any condensation product.

Bis(4-nitrophenyl)thiazolothiazole, obtained by nitration of diphenylthiazolothiazole or better by the condensation of *p*-nitrobenzaldehyde and dithiooxamide, was reduced by prolonged refluxing with butanolic hydrochloric acid and tin to furnish an almost quantitative yield of bis(4-amino-phenyl)thiazolothiazole.

Bis(2-phenylvinyl)thiazolothiazole obtained from cinnamaldehyde and dithiooxamide was oxidized by potassium permanganate in pyridine to furnish an 80% yield of thiazolothiazoledicarboxylic acid, which was characterized as its dimethyl ester. This dibasic acid was decarboxylated to afford an 80% yield of the parent heterocycle, thiazolothiazole (IV, R=H). This is a colorless crystalline substance, m.p. 150-152°, that has a very simple infrared spectrum containing only seven or eight bands. The spectrum is consistent with the fully aromatic, highly symmetrical structure that has been proposed.

81 pages. \$1.50. Mic 56-2483

I. THE ACTION OF GRIGNARD REAGENTS ON *o*-DUROYLBENZOPHENONE II. OXIDATION OF THE ENOL FORM OF 1,2-DIMESITOYLCYCLOHEXANE

(Publication No. 18,161)

Roger Harris Kottke, Ph.D.
University of Illinois, 1956

Part I:

In the preparation of *o*-duroyltriphenylcarbinol from methyl *o*-duroylbenzoate and phenylmagnesium bromide, *o*-duroylbenzohydrol was also obtained. Two of the possible mechanisms for this transformation were studied in detail.

No *o*-duroylbenzohydrol could be isolated when *o*-duroylbenzophenone, the hypothetical precursor of the secondary alcohol, was treated with magnesium methoxide or magnesium bromomethoxide. Likewise, no reduction was observed when methyl *o*-duroylbenzoate was allowed

to react with phenylmagnesium bromide in the presence of methanol or when isopropyl *o*-duroylbenzoate was treated with phenylmagnesium bromide. This evidence shows that methoxide ion is not the reducing agent in the reaction. Aluminum isopropoxide reacted with *o*-duroylbenzophenone, but only under more strenuous conditions than those required for the preparation of *o*-duroylbenzohydrol, and both carbonyl groups were reduced.

Vigorous treatment of the diketone with the binary mixture, Mg+MgBr₂, gave rise to a complex mixture of products from which no pure compounds could be isolated. When methyl *o*-duroylbenzoate was condensed with phenylmagnesium bromide in the presence of magnesium and magnesium bromide, no reduction product was isolated. Evidently, if reduction is to occur, the reaction conditions must be carefully controlled.

The effect of the *o*-duroyl group in *o*-duroylbenzophenone has been found to be primarily a steric one. The duroyl group shields the other carbonyl group sufficiently to impair reaction at this position but does not inhibit it. A 2,4-dinitrophenylhydrazone was prepared from the diketone by using conditions more strenuous than are usually employed. The reaction of *o*-duroylbenzophenone with isopropylmagnesium bromide was similar to the reactions observed with the phenyl and *o*-tolyl Grignard reagents; a 1,2-addition occurred. When the diketone was treated with *t*-butylmagnesium chloride no reaction was observed unless forcing conditions (24 hours at 140°) were employed. The product, which could not be purified and has not been completely characterized, appears to be the compound resulting from the addition of the Grignard reagent to the disubstituted benzene ring. The different type of reaction that took place when the diketone was allowed to react with this reagent is viewed as being due to the greater bulk of the *t*-butyl group.

Part II:

trans-1,2-Dimesitoylcyclohexane was treated with the ethyl and methyl Grignard reagents; the same product was obtained from each reaction. Combustion analysis indicated that the compound was an oxidation product of 1,2-dimesitoylcyclohexane. By means of carefully controlled conditions during the reaction, it was shown that the enol which results from treatment of the diketone with a Grignard reagent is easily autoxidized to give the product. On the basis of chemical and physical evidence the compound has been postulated to be *trans*-1,2-dimesitoyl-7-oxabicyclo[2,2,1]heptane. The reaction goes in high yield and the structure of the product is different from those of any other known compounds obtained by a similar oxidation.

135 pages. \$1.80. Mic 56-2484

THE SYNTHESIS OF DERIVATIVES OF
ALKYLATED AND ARYLATED PIPERIDONES
FOR CHEMOTHERAPEUTIC STUDIES

(Publication No. 17,249)

Everett A. Mailey, Ph.D.
University of Pennsylvania, 1956

Supervisor: Professor Allan R. Day

The following 4-piperidones were used as intermediates in this investigation: 2,2,6,6-tetramethyl; 2,2,6-trimethyl; 1,2,2,6,6-pentamethyl; 1-methyl; 1-methyl-3-carbethoxy; 2,6-diphenyl-3-methyl; 2,6-diphenyl-3,3-dimethyl; 2,6-diphenyl-3,5-dimethyl; and 1,3-dimethyl-2,6-diphenyl.

Nine new spirohydantoin have been made from the above compounds.

The phenacyl condensation of the alkylated piperidones was unsuccessful, whereas in the case of the phenylated piperidone, the condensation proceeded smoothly.

Four new N-phenacyl compounds and their reduction products were prepared.

Although the 2,2,6-trimethyl-4- α -piperidinol and 2,2,6-trimethyl-4- β -piperidinol were reported in the literature, the methods of their preparations were new.

Two new 4-piperidinols were prepared. Some p-nitro and p-aminobenzoates of 4-piperidinols were prepared. Three new N- β -hydroxyethylamines were prepared. Three new quaternary compounds of the above products were made.

A representative number of the above compounds is being tested for activity. 71 pages. \$1.50. Mic 56-2485

POLAROGRAPHIC INVESTIGATION OF LAKES
OF SOME HYDROXYANTHRAQUINONES

(Publication No. 18,081)

Vsevolod Mihajlov, Ph.D.
Clark University, 1956

Supervisor: Jesse L. Bullock

A complicated method of mordant dyeing known to the ancient world was used in applying alizarin, a principal coloring matter of madder. Although this method grew in importance, very little if anything was known about the structure of lakes.

Two theories dealing with the theory of alizarin lakes were advanced. According to one of these theories, the lakes are complexes, in which the metal is combined with the dye through a coordinate linkage to quinone group and an ionic linkage to the hydroxyl group, yielding a six membered chelate ring.

According to the second theory, lakes are considered to be ionic salts, in which the metal ion is bound to two hydroxyl groups by ionic bonds.

This investigation was undertaken in order to throw more light on this question which might help to obtain specific information about the structure of the alizarin lakes.

Polarography was chosen as the tool for this work. If the lakes were an ionic salts, both metal and the dye would

be reduced at their half wave potentials, thus producing two separate waves, one due to metal, the second one due to dye.

If the lake however were a complex, one should obtain three separate waves, one due to metal, second one due to dye and the third one due to lake, providing the lake were reducible.

Alizarin-3-sulfonate was chosen for this work because of its considerable solubility in water. Quinizarin-2-sulfonate was selected as an hydroxyanthraquinone which has no hydroxyl groups in position 2 and which according to the ionic theory should not be able to form a lake.

Standard polarographic technique was used throughout the whole investigation.

Polarographic behavior of alizarin-3-sulfonate in buffered media corresponds essentially to the theoretical requirements for quinones.

The heights of the waves are directly proportional to concentrations. The slopes were close to .059/2, indicating a reversible 2 electron reaction, i.e. a hydroquinone formation. A plot of half-wave potentials vs. pH gave a straight line with a slope of .058, standard reduction potential of alizarin-3-sulfonate, as calculated from these data is equal to -.185 v. against the saturated calomel electrode.

Quinizarin-2-sulfonate was reduced by a two electron process to hydroquinone in acid media, in alkaline media the reduction led to formation of semiquinone.

The lakes of alizarin-3-sulfonate are complexes, which is proven by the fact, that the dye and metal form a compound which is not reducible polarographically.

The polarographic data also show that the formation of lakes is a rather slow process, requiring as much as 300 hours to reach the equilibrium. The formation of aluminum lake takes place in two steps, the first a rapid one leading to formation of a 2:1 lake, followed by a slower step, in which a 3:1 lake is formed. At pH 6.10 aluminum forms a 3:1 lake. Copper forms in both cases a 2:1 lake. No lakes were formed at pH 2.50.

The behavior of quinizarin-2-sulfonate lakes is similar to the behavior of alizarin-3-sulfonate lakes. Although quinizarin-2-sulfonate has two OH groups alpha to carbonyl groups, only one of them participated in lake formation.

At pH 9.10 quinizarin-2-sulfonate and aluminum form a 2:1 lake, which upon addition of additional amount of dye goes over onto a 4:1 lake. No results could be obtained at pH 6.10, because of the fact that the lakes formed precipitated out. No lakes were formed at pH 2.50.

The fact that quinizarin-2-sulfonate, which has no hydroxyl in position 2, forms lakes is an additional proof that the lakes are complexes and not ionic salts.

Since none of the lakes studies were polarographically reducible, nothing can be said about their stability constants, except that they must be very small, i.e. that the lakes are very stable. 102 pages. \$1.50. Mic 56-2486

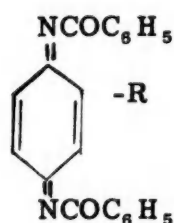
ORIENTATION IN ADDITIONS TO SUBSTITUTED p-QUINONEDIBENZIMIDES

(Publication No. 18,177)

Mohanan Damodaran Nair, Ph.D.
University of Illinois, 1956

Previous investigations on the orientation in adducts of p-quinonediimides have revealed important differences in the nature of addition to substituted p-quinonedibenzimides and substituted p-quinonedibenzenesulfonimides. This research was undertaken to study the factors which influence orientation in the final adducts of various p-quinonediimides.

Hydrogen chloride was added to 2-methyl-, 2-phenylmercapto- and 2-benzenesulfonyl-p-quinonedibenzimides (Ia, b and c). The orientation in the adduct from 2-methyl-



I

R a = -CH₃
 b = -SC₆H₅
 c = -SO₂C₆H₅

imide was shown to be 1,2,4,6 by an unequivocal synthesis of 6-chloro-2-methyl-p-phenylenedibenzamide. 2-Phenylmercapto imide gave 3-chloro-2-phenylmercapto-p-phenylenedibenzamide and 2-benzenesulfonyl imide yielded a mixture of 2-benzenesulfonyl-3-chloro- and 2-benzenesulfonyl-6-chloro-p-phenylenedibenzamides. The structures of the adducts were proven by unequivocal methods.

Thiophenol and benzenesulfinic acid were added to 2-chloro-, 2-phenylmercapto- and 2-benzenesulfonyl-p-quinonedibenzimides. The 2-chloro imide gave adducts with 1,2,4,5 orientation in both additions. The 2-phenylmercapto imide added thiophenol to give a product with 1,2,3,4 orientation, but with benzenesulfinic acid it gave a mixture of adducts with 1,2,3,4 and 1,2,4,6 orientations, the latter predominating. 2-Benzenesulfonyl imide on addition of benzenesulfinic acid gave a product with 1,2,4,6 orientation accompanied by traces of 1,2,3,4 isomer.

Investigation into the p-quinonedibenzenesulfonimide series showed that addition of thiophenol to 2-phenylmercapto-p-quinonedibenzenesulfonimide resulted in 2,5-diphenylmercapto-p-phenylenedibenzenesulfonamide. Addition of benzenesulfinic acid to 2-benzenesulfonyl-p-quinonedibenzenesulfonimide gave an adduct with 1,2,4,6 orientation.

Addition of thiophenol and benzenesulfinic acid to 2-chloro-p-quinonedimethanesulfonimide yielded adducts with 1,2,4,5 orientations. Addition of hydrogen chloride to 2-phenylmercapto-p-quinone dimethanesulfonimide also gave an adduct with 1,2,4,5 orientation. These results were found to be analogous to those in the benzenesulfonimide series.

Acetylacetone, benzoylacetone, ethyl acetoacetate and diethyl malonate were added to 2-benzenesulfonyl-p-quinonedibenzimide. The acetylacetone and benzoylacetone adducts were cyclized to give the same substituted indole. Aniline, morpholine and piperidine added to 2-benzenesulfonyl-p-quinonedibenzimide to give normal adducts.

Thiophenol and benzenesulfinic acid were added to 2-

methyl-p-quinonedibenzimide to give adducts with identical orientations. Hydrazoic acid reacted with 2-methyl-p-quinonedibenzimide to give an azido compound which was reduced with sodium hydrosulfite to an amine. An attempted Sandmeyer reaction on this amine resulted in the formation of a substituted benzotriazole.

179 pages. \$2.35. Mic 56-2487

THE HYDROGENATION AND HYDROGENOLYSIS OF ALLYLIC AMINES

(Publication No. 18,336)

Edward Mahlon Perry, Ph.D.
The University of Connecticut, 1956

This work was undertaken to study the conditions under which hydrogenation and hydrogenolysis of allylic and benzylic amines can take place. The first object was to observe the differences in several catalytic and non-catalytic methods of reduction on the hydrogenation and hydrogenolysis of allylic amines. It was hoped that conditions would be found that would permit the hydrogenation without hydrogenolysis, and the reverse: cleavage without saturation.

A secondary objective was to study the effect of the same catalytic and non-catalytic reductive methods on the hydrogenolysis of benzyl amines to determine the optimum conditions for cleavage of the molecule.

N,N,N',N'-Tetrabutyl-2-butene-1,4-diamine was chosen as the allylic amine, largely because of work that had been done with it previously in this laboratory. Since dibutylcrotylamine could be a product or an intermediate in the cleavage of the diamine, it was included in the study. Benzylidibutylamine was selected as the benzyl amine to be studied.

The methods of reduction employed in this study were: lithium aluminum hydride, tin and hydrochloric acid, sodium amalgam and ethyl alcohol, aluminum and sodium hydroxide, Raney nickel alloy and sodium hydroxide, and catalytic hydrogenation with palladium, platinum, Raney nickel, and copper chromium oxide. The catalytic reductions with palladium and with platinum were run in methyl alcohol, hexane, acetic acid. Hexane and methyl alcohol were used as solvents for the reactions with Raney nickel. The amine hydrochlorides also were run with palladium and with platinum in methyl alcohol.

The extent of hydrogenation and hydrogenolysis was determined by the isolation and identification of the products of the reactions.

The best conditions for the saturation of the allylic double bond are by catalytic hydrogenation of the amine hydrochloride with 10% palladium catalyst in methyl alcohol solution. There is no complication of hydrogenolysis under these conditions and the saturated amine can be isolated in good yields.

Reduction with lithium aluminum hydride in butyl ether at 120°C. gave hydrogenolysis of N,N,N',N'-tetrabutyl-2-butene-1,4-diamine without the complication of hydrogenation of the double bond. However, this method of reduction gave neither cleavage nor hydrogenation of the dibutylcrotylamine, so it is not a general reaction that occurs with all allylic amines.

The best catalytic method of cleaving allylic amines is with a platinum catalyst in methyl alcohol solution. Nevertheless, the extent of cleavage even by this catalytic method is small since hydrogenation of the double bond competes with the cleavage reaction; the saturated amine is resistant to cleavage by this method.

The optimum condition for the hydrogenolysis of benzyl amines is with 10% palladium on charcoal in methyl alcohol solution. The reaction is fast and complete, and the products can be isolated with a minimum of manipulation.
152 pages. \$2.00. Mic 56-2488

SYNTHESIS AND REACTIONS OF EPOXIDES IN THE CYCLOPENTANE AND CYCLOHEXANE SERIES

(Publication No. 17,267)

Theodore Harold Roberts, Ph.D.
University of Pennsylvania, 1956

Supervisor: Dr. Frederick V. Brutcher

The primary object of this study was the investigation of planar four center transition states and the importance of orbital overlap in these states.

Five and six member alicyclic rings were chosen as model compounds. The six member ring possesses axial and equatorial bonds, while the five member ring, presumably planar, has its bonds in intermediate positions.

The opening and closing reactions of cyclopentene oxide and cyclohexene oxide were studied. The differences in rates were small, 13.5 to 15 fold. Although the five member ring was slower in the opening reaction, it was faster in the closing reaction.

TABLE I

Velocity Constants, Activation Energies, Activation Entropies, and Free Energies of Activation for the Anhydrous, Acid Catalyzed Opening of Epoxides					
Epoxide	Temp. °C.	k l./mole min.	E _a Cal./mole	ΔS‡ e.u.	ΔF‡ 25° cal./mole
Cyclohexene Oxide	25	1.631 ± 0.135	6,593 ± 615	-45.39 ± 1.57	19,527 ± 771
	12	0.978 ± 0.070			
	-22.8	0.195 ± 0.012			
Cyclopentene Oxide	25	0.153 ± 0.008	8,787 ± 434	-42.45 ± 0.95	20,845 ± 516
	12	0.0784 ± 0.0053			
	-22.8	0.00872 ± 0.00043			

Qualitative work in the enolization field again indicated that the five member ring was more reactive than the six member ring by a factor of 12.

TABLE II

Velocity Constants, Activation Energies, Activation Entropies and Free Energies of Activation for the Aqueous, Base Catalyzed Closing of Epoxides					
Chlorohydrin	Temp. °C.	k l./mole min.	E _a cal./mole	ΔS‡ e.u.	ΔF‡ 25° cal./mole
Trans-2-Chlorocyclohexanol	50	127 ± 7	17,020 ± 342	-5.94 ± 0.77	18,198 ± 410
	25	15.10 ± 0.59			
	0	0.963 ± 0.063			
Trans-2-Chlorocyclopentanol	50	1715 ± 142	16,420 ± 433	-1.56 ± 1.04	16,293 ± 533
	25	203 ± 11.1			
	0	15.96 ± 1.25			

In certain cases, where the four center effects were supposed to be dominant, the five member ring was found to react faster than the six member ring.

TABLE III

Velocity Constants Activation Energies, Activation Entropies and Free Energy of Activation for the Alkaline Bromination of Ketones					
Ketone	Temp. °C.	k min. ⁻¹	E _a cal./mole	ΔS‡ e.u.	ΔF‡ cal./mole 25°
Cyclohexanone	35	0.0475 ± 0.0015	13,990 ± 329	-29.33 ± 0.78	22,138 ± 404
	25	0.0224 ± 0.0003			
	15	0.00973 ± 0.00018			
Cyclopentanone	35	0.476 ± 0.0009	10,870 ± 280	-34.85 ± 0.67	20,668 ± 344
	25	0.259 ± 0.004			
	15	0.139 ± 0.003			

This necessitated a consideration of the planarity of the cyclopentane ring. Infrared data were obtained which showed that alpha-chlorocyclopentanone was puckered, Table IV.

It was estimated for cyclopentane that a displacement of 0.75 Å of one of the carbon atoms out of the plane of the ring would require an energy expenditure of not more than 6-7 Kcal./mole and would orient two trans substituents in a coplanar configuration.

These results indicate a strong similarity between five and six member alicyclic rings with respect to planar four center effects. Therefore, the use of a system more rigid than the five member ring would be deemed advisable in further evaluation of planar four center effects.

TABLE IV

INFRARED ABSORPTION DATA

Compound	max C = O cm ⁻¹	Shift due to alpha bromine cm ⁻¹
Cyclopentanone	1742	- - -
α-Bromocyclopentanone	1750	8
α-Chlorocyclopentanone	1755	13*
Cyclohexanone	1712	- - -
α-Bromocyclohexanone	1716	4
α-Chlorocyclohexanone	1722	10*
Camphor	1744	- - -
α-Bromocamphor	1758	14
α,α-Dibromocamphor	1766	22
α-Chlorocamphor	1763	19

The infrared studies were made in carbon tetrachloride solution.

We are indebted to Samuel Barr for his aid in the preparation of these compounds.

224 pages. \$2.90. Mic 56-2489

*E. J. Corey, J. Am. Chem. Soc., 75, 2301 (1953).

PREPARATION OF BENZIMIDAZOLYL AND PYRIDIMIDAZOLYL ALPHA AMINO ACIDS

(Publication No. 17,268)

Ralph L. Rogers, Ph.D.
University of Pennsylvania, 1956

Supervisor: Allan R. Day

Although benzimidazole and its derivatives have exhibited a variety of physiological activities, none of them

have been outstanding enough to warrant extensive use of the compounds as drugs. It is our hope that alpha amino acid side chains may enhance the effect of the benzimidazoles by presenting to the organism a molecule which will be accepted and incorporated in its protein synthesis.

β -(Benzimidazolyl-2)-alanine, (I), β -(5-methylbenzimidazolyl-2)-alanine, (II), and β -(2,3-pyridimidazolyl-2)-alanine, (III) each may be reasonably expected to be an antagonist for phenylalanine, histidine, and tryptophane. β -(Benzimidazolyl-5)-alanine, (IV) also may prove to be an antagonist for phenylalanine. δ -(Benzimidazolyl-2)-norvaline, (V) and its 5-methyl homologue, (VI) may prove to be antagonists for lysine. It also appeared desirable to prepare the compound intermediate between I and V, that is γ -(benzimidazolyl-2)- α -aminobutyric acid, (VII) and its 5-methyl homologue, (VIII).

The diethyl formamidomalonate, (IX), synthesis was used throughout. 2-Chloromethylbenzimidazole, 2-chloromethyl-5-methylbenzimidazole, and 2-chloromethylimidazo[b]pyridine were each condensed with IX. The products were hydrolyzed and decarboxylated by heating with HCl to yield I, II, and III respectively. Since the last molecule of water of crystallization is extremely difficult to remove from these compounds, we propose that it may be hydrogen bonded to both the amino nitrogen and the heterocyclic nitrogen to form an additional heterocyclic ring.

The syntheses of IV, V, VI, VII, and VIII were not successful. Lithium aluminum hydride reduction of 5-carboxybenzimidazole or its methyl ester could not be accomplished. Nor could oxidation of 5-methylbenzimidazole to the aldehyde be accomplished reliably in yields as large as 10%. Thus the route to 5-hydroxymethylbenzimidazole, 5-chloromethylbenzimidazole, and IV was blocked.

2-(β -Chloroethyl)-benzimidazole and its 5-methyl homologue suffered loss of HCl to yield 2-vinylbenzimidazoles and polymers, when placed in sodium ethoxide solution with IX. Thus this route to VII and VIII was blocked.

2-(3-Chloropropyl)-benzimidazole lost HCl to form pyrrolido[a]-benzimidazole instead of reacting with IX in sodium ethoxide solution. o-Nitroaniline was benzylated and converted into 1-benzyl-3-chloropropylbenzimidazole. Neither this compound nor its 5-methyl homologue could be made to react with IX. Thus this syntheses of V and VI failed also.

90 pages. \$1.50. Mic 56-2490

STUDIES IN MEDICINAL CHEMISTRY THE PREPARATION OF 2-(DIALKYLAMINO- ALKYLAMINO)DIPHENYL SULFIDES

(Publication No. 17,628)

Joseph LeRoy Stanmyer, Jr., Ph.D.
University of Virginia, 1956

The purpose of this investigation was the preparation of certain nuclear chlorinated derivatives of 2-(dialkylaminoalkylamino)diphenyl sulfide as "open" analogs of similarly substituted phenothiazines that are useful as antiemetic and tranquilizing drugs.

The first section concerns a general review of 2-aminodiphenyl sulfide and its derivatives.

The second section describes the preparative methods employed. Suitably substituted benzenethiols were reac-

ted, in alkaline ethanolic solution, with various chloronitrobenzenes to yield substituted 2-nitrodiphenyl sulfides. These were reduced to the corresponding amino sulfides with hydrazine hydrate in the presence of catalytic amounts of Raney nickel. The N-substituted derivatives were arrived at by treating the amines with 3-chloropropionyl chloride, and aminating the resultant 2-(3-chloropropionamido)diphenyl sulfides with dimethylamines. The 3-dimethylaminopropionamido sulfides were reduced to the corresponding 2-(3-dimethylaminopropylamino)diphenyl sulfides with lithium aluminum hydride. In one case it was possible to prepare the dialkylaminoalkyl derivative directly from the amine by reacting the latter with 3-dimethylaminopropyl chloride in the presence of sodium hydride.

It was also shown that 2-acetamidodiphenyl sulfoxide, unlike its phenothiazine-5-oxide counterpart, will not undergo reductive halogenation with hydrochloric or hydrobromic acid to give a haloacetamidodiphenyl sulfide. Deacetylation and reduction of the sulfoxide to 2-amino-diphenyl sulfide were found to occur under these conditions.

119 pages. \$1.50. Mic 56-2491

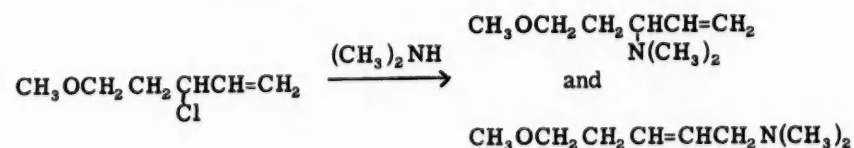
INFLUENCE OF STERIC FACTORS IN AMINATIONS OF ALLYLIC CHLORIDES

(Publication No. 18,340)

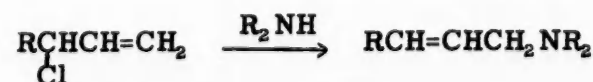
Russell Irwin Steiner, Ph.D.
The University of Connecticut, 1956

The purpose of this investigation was to study the effect of steric factors on the course of the reaction of secondary allylic chlorides with secondary amines. The reactions of 3-chloro-5-methoxy-1-pentene and 3,4-dichloro-1-butene with secondary amines of differing steric proportions were studied, keeping constant as many other factors as possible.

It is known that the secondary allylic chloride, 3-chloro-5-methoxy-1-pentene, produces, in addition to the expected rearranged product, a considerable quantity of normal displacement product when treated with dimethylamine in polar solvent.¹



Most other secondary allylic chlorides of analogous structure seem to give complete rearrangement upon amination.^{2, 3, 4}



The secondary chloro ether is probably unique among other secondary allylic halides so far studied in its tendency to produce normal displacement product. However, since amines having greater steric requirements than dimethylamine have been used in the other cases, it seems possible that the smaller steric requirements of the dimethylamine might be responsible for the unusual result with the chloro ether.

In order to investigate the effect of amine size in promoting allylic rearrangement, the aminations of 3-chloro-5-methoxy-1-pentene and 3,4-dichloro-1-butene were studied using morpholine, piperidine and pyrrolidine (amines having smaller steric requirements than dimethylamine) and using diethylamine and diisopropylamine (greater steric requirements than dimethylamine).

When the chloro ether was aminated with morpholine, piperidine and pyrrolidine, 55-60% of the total yield was normal product. Dimethylamine gives only 40% of the non-rearranged product. The results with the larger amines, diethylamine and diisopropylamine, were less conclusive. The amount of normal product obtained was 35-38%, a decrease from the dimethylamine figure so slight that it may well be fortuitous. The steric requirement of the amine thus appears to be only a minor factor in determining the extent to which rearrangement takes place.

All aminations of 3,4-dichloro-1-butene gave only rearranged products as they have previously with other amines,⁴ steric factors having no discernible effect.

The reactions of the unsubstituted allylic chlorides, 3-chloro-1-butene and 3-chloro-1-pentene, studied by other workers^{2,3} in non-polar solvents, were reinvestigated in polar solvent, conditions more conducive to normal displacement.¹ However, the reactions led to complete rearrangement with the production of no detectable quantity of normal product. The chloro ether does indeed seem to be unique.

The proposal that amines of greater base strength tend more to give rearranged products^{5,6} was also investigated. It was found that basicity has no effect on the ratio of normal to rearranged products.

This investigation shows that the unusual tendency to give normal displacement is a property of 3-chloro-5-methoxy-1-pentene and not of the particular secondary amine used. The steric requirement of the amine has little effect on the amount of normal displacement, and the basicity of the amine apparently has no effect.

BIBLIOGRAPHY

1. Brill, Ph.D. Thesis, University of Connecticut, 1950.
2. Young, Webb and Goering, J. Am. Chem. Soc. **73**, 1076 (1951).
3. Meisenheimer and Link, Ann. **479**, 211 (1930).
4. Rothschild, Ph.D. Thesis, University of Connecticut, 1952.
5. Jones, Lacey and Smith, J. Chem. Soc. 1946, 940.
6. Pudovik, J. Gen. Chem. (U.S.S.R.) **21**, 1642 (1951).

94 pages. \$1.50. Mic 56-2492

THE DECOMPOSITION OF 5-SUBSTITUTED 3-NITROSO-2-OXAZOLIDONES

(Publication No. 17,407)

Alan Edward Weinberg, Ph.D.
The Ohio State University, 1956

The thermal decomposition of a series of 5-substituted 3-nitroso-2-oxazolidones, namely, 3-nitroso-5,5-diphenyl-2-oxazolidone (I), 3-nitroso-5-methyl-5-phenyl-2-oxazo-

lidone (II), and 3-nitroso-1-oxa-3-azaspiro [4.5] decan-2-one (III), was investigated, the results were described, and a mechanism was proposed.

The chief product, in all cases, was the parent oxazolidone. When at least one of the substituents was phenyl, as in I and II, the by-products were 1,1-disubstituted ethylenes, ketones, and disubstituted acetylenes. The ketones were the result of oxidative cleavage of the ethylenic bond by nitric oxide. The acetylenes, which had the same number of carbons as the ethylenes, were the result of a rearrangement presumably involving the migration of a phenyl group. The by-products from III were a small amount of ketone and a large amount of tar.

The effect of temperature on the amounts of decomposition products of I was studied. In addition, a quantitative mass spectrometric analysis of decomposition gases of I was made.

The effect of organic solvents on the mode of decomposition was studied for I, II, and III. When unsymmetrical disubstituted ethylenes and compounds containing benzyl hydrogens were the solvents, a very high yield of oxazolidone was obtained, the only by-products resulting from oxidation of the solvent by nitric oxide.

3-Nitrosospiro[fluorene-9', 5-oxazolidin]-2-one, IV, was prepared and decomposed with potassium hydroxide in methanol. The chief product was 9-(methoxymethylene) fluorene, V. This result offered good supporting evidence for the existence of an unsaturated carbonium ion during the basic decomposition of IV.

82 pages. \$1.50. Mic 56-2493

CHEMISTRY, PHARMACEUTICAL

PREPARATION OF p-THYMOTINIC ACID AND SOME OF ITS DERIVATIVES

(Publication No. 18,317)

LeRoy Duane Beltz, Ph.D.
The University of Connecticut, 1956

Several methods were attempted for the synthesis of p-thymotinic acid. The Reimer-Tiemann reaction provided the best results for production of the acid in quantity. Neutralization equivalents for the acid and for its derivatives which involved only the phenolic hydroxyl group were determined potentiometrically. The potentiometric titration of p-thymotinic acid gave only one inflection in the curve; an inflection corresponding to the phenolic hydroxyl group was not observed. The acid was nitrated and brominated, yielding mono-substituted derivatives. Derivatives prepared through the carboxyl group included the methyl, ethyl, p-bromophenacyl, p-chlorophenacyl and p-nitrobenzyl esters and eleven metallic salts. Phenolic derivatives included the α -naphthyl- and phenylthiourethan, the acetate and 3,5-dinitrobenzoate and the oxyacetic acid.

49 pages. \$1.50. Mic 56-2494

THE PREPARATION, PARTIAL PURIFICATION,
AND APPLICATION OF A CELLULASE FROM
MYROTHECIUM VERRUCARIA

(Publication No. 17,144)

William Roth, Ph.D.
University of Washington, 1956

The use of a mild treatment to facilitate release of active constituents from plant drugs involved consideration of the use of enzymic means to penetrate and break down the cell walls of the drugs. Since plant cell walls are composed largely of cellulose, experiments were conducted to develop methods for preparation of a cellulolytic enzyme, to study the characteristics of the purified enzyme, cellulase, and to produce sufficient enzyme for an exploratory investigation of its application in plant drug extraction.

Cellulase was obtained from the culture medium of Myrothecium verrucaria grown on cotton in a mineral nutrient solution. A study of the addition of yeast extract to the nutrient showed no increase in cellulase production. The filtrate of the mold culture was deionized by passage through a monobed column of Amberlite IR 120 (H) and Amberlite IRA 400 (OH) with 35-50% loss in total protein, but with no loss in activity of the protein that passed through. The deionized filtrate was concentrated in a low temperature evaporator at 25-30° C and reduced to a dry state by lyophilization. A solution of the freeze-dried material, equivalent to 1% protein, was made in 0.01 M acetate buffer at pH 5.0 and the protein was fractionally precipitated with alcohol to obtain fractions with high cellulase activity at concentrations of 30-50% alcohol. Purified cellulase was obtained from a 1% protein solution of the 30-50% alcohol fraction at pH 4.35 in 0.01 M acetate buffer by precipitation with an equal volume of 0.25% polymethacrylic acid in the same buffer. The polymethacrylic acid precipitate of the enzyme was dissolved in 0.05 M acetate buffer at pH 6.5 and the polymethacrylic acid was removed by precipitation with 10% barium chloride solution. Starch electrophoresis of this purified cellulase showed one major component and traces of two others.

A study of the characteristics of the enzyme on regenerated cellulose substrate showed optimum activity at 40° C and in the pH range of 5.7-6.5. The rate of hydrolysis of the substrate by the enzyme proceeded uniformly for the first four hours and decreased rapidly thereafter. On addition of bovine plasma activator, the optimum pH range shifted to 5.0-5.7 and the rate of hydrolysis increased, conforming to a first order reaction.

The activity of the enzyme was obtained by colorimetric determination of reducing substances (as glucose) produced by low concentrations of the cellulase in the presence of excess substrate and in 0.05 M acetate buffer at pH 5.6. In the eight hour assay period used the enzyme action was inhibited above limiting concentrations of glucose produced.

A variation of the purification procedure was carried out, as a preparative method, to obtain a better recovery of enzyme protein. The concentrate from the low temperature evaporator was held at 0-2° C and the low activity precipitate that formed was removed. The remaining concentrate was freeze dried, and fractionally precipitated with alcohol to remove low activity protein at 20% alcohol and to obtain a high activity protein at 50% alcohol. Starch electrophoresis of this fraction showed the presence of only two components.

The 50% alcohol fraction (preparative method) was used, without success, in an attempt to facilitate the extraction of strychnine from *Nux Vomica*.

71 pages. \$1.50. Mic 56-2495

CHEMISTRY, PHYSICAL—

THE CRYSTAL STRUCTURE OF PENTANAMIDE

(Publication No. 17,113)

Robert Francis Adamsky, Ph.D.
University of Washington, 1956

An interest in the solid state properties of paraffin chain compounds has led to an investigation of the non-homologous properties of the n-aliphatic amides. The determination of the crystal structure of pentanamide was undertaken in order to obtain, if possible, an explanation for the anomalously high melting point of the compound, and the variation of the *b* unit cell dimension from that found for other amides.

The structure was obtained by the direct determination of the phases of structure factors, and refined by standard two-dimensional techniques. The similarities with the structure of tetradecanamide predicted by a previous worker have been corroborated, and while some essential differences were found, no feature of the structure could be correlated with the high melting point.

By investigation of optical properties of crystals of pentanamide at varying temperatures, a phase transformation was detected at 85° C. The melting behavior was therefore attributed to properties existent in the high temperature structure modification.

94 pages. \$1.50. Mic 56-2496

RADIATION CHEMISTRY STUDIES ON FERROUS,
CERIC, DICHROMATE AND PERMANGANATE
SOLUTIONS WITH HIGH INTENSITY X-RADIATION

(Publication No. 17,101)

Edward L. Alexander, Ph.D.
Vanderbilt University, 1956

Supervisor: Dr. M. D. Peterson

The radiation chemistry of four oxidizing and reducing systems under the influence of very high intensity, low energy x-rays was studied, and the G yields (number of ions oxidized or reduced per 100 electron volts absorbed) for the ions under investigation were calculated. In conjunction with these experiments a physical-chemical dosimetry investigation was conducted on the x-ray beam itself. This beam was produced by equipment especially designed to operate at 50 ma and 50 PKV continuously.

The method chosen to determine the energy output and dose rate available from the x-ray tube was one of direct calorimetric measurement combined with the air-saturated ferrous sulfate-sulfuric acid chemical actinometer. In ad-

dition, a complete investigation of the ferrous sulfate-sulfuric acid system was undertaken; first to determine its behavior under the influence of very high intensity radiation using relatively high concentrations of ferrous ion, and secondly to determine its value as a chemical dosimeter under these conditions. The oxidation of the ferrous sulfate was shown to be independent of ferrous ion concentration over the range of 10^{-2} to 10^{-3} equivalents per liter and independent of sulfuric acid concentration from 0.1 N to 1.0 N. The addition of either air, argon, oxygen or hydrogen did affect the oxidation yield to some extent, but the oxidation was shown to be independent of dose rate up to a value of 2.16×10^6 roentgens per minute which was calculated for the x-ray tube from air absorption measurements.

The reduction of ceric sulfate in sulfuric acid solution was also studied in order to investigate the possibility of using this system as a chemical actinometer, as well as to determine the behavior of the system under the influence of very high intensity radiation. The reduction of the ceric ion was shown to be independent of cerium concentration between 10^{-2} and 10^{-3} equivalents per liter and also independent of dose rate up to 2.16×10^6 roentgens per minute. There did appear to be a slight dependency of reduction yield upon sulfuric acid concentration with the yield at 0.2 N acid being about 10% higher than the yield at 0.8 N. The saturation of the solutions with gases other than air gave no appreciable effect.

The radiation chemistry of solutions of potassium dichromate and potassium permanganate was studied in respect to reduction products, acid dependency and rates of decomposition. In both cases the rates of reduction and also the final reduction products were found to depend strongly upon the concentration of sulfuric acid used. The dichromate showed a reduction from hexavalent chromium to trivalent chromium in air-saturated 0.4 N sulfuric acid, but yielded a reduction of hexavalent chromium to quadrivalent chromium in solutions of pH 4.5 to 7.0. The dichromate solutions were more stable at a pH of 3.0 than at higher or lower acid concentrations, and appeared to be completely stable under alkaline conditions. The addition of hydrogen in neutral solutions restored the hexavalent to trivalent chromium reduction, and re-oxidation of the trivalent to hexavalent chromium in air-saturated 0.4 N acid solution was found after removing the solutions from the radiation beam. The potassium permanganate gave a total reduction of heptavalent manganese to quadrivalent manganese in strong sulfuric acid solutions (up to 3.0 N), but showed reductions to both quadrivalent and hexavalent manganese in neutral solutions. The addition of hydrogen in the case of the manganese reductions favored the formation of the higher valence state reduction product. Both the potassium dichromate and the potassium permanganate reductions were shown to be independent of anion concentration over the range of 10^{-2} to 10^{-3} equivalents per liter, and also independent of dose rate up to 2.16×10^6 roentgens per minute.

106 pages. \$1.50. Mic 56-2497

THE CRYSTAL STRUCTURES OF HYDROXYLAMINE-O-SULFONIC ACID AND POTASSIUM HYDROXYLAMINE-N-SULFONATE

(Publication No. 17,459)

Roger Francis Belt, Ph.D.
State University of Iowa, 1956

Chairman: Professor Norman C. Baenziger

The crystal structure of potassium hydroxylamine-N-sulfonate, KSO_3NHOH , was determined from Weissenberg and precession data. The crystals are orthorhombic with cell dimensions $a = 7.06$, $b = 12.02$, and $c = 5.58\text{\AA}$. There are four molecules in the unit cell and the space group is $P2_12_12_1$. The potassium and sulfur atoms were located by the Patterson method. The remaining atoms were then able to be located by means of steric considerations and a close examination of intensity data. Initial parameters of all atoms were obtained by Fourier projections on (001), (100), and (010). Because all atoms were not clearly resolved, a three dimensional refinement was carried out by least squares methods employing an IBM 704 computer. Calculations from the final least squares coordinates showed that the sulfur atom is surrounded nearly tetrahedrally by three of the oxygens and a nitrogen atom. S-O bond lengths are 1.46, 1.46, and 1.48Å, while the S-N distance is 1.67Å. The remaining oxygen atom is bonded to the nitrogen at a distance of 1.51Å. Each of the potassium ions is coordinated by eight nearest neighbors, four at a mean distance of 2.77Å, and four others at a distance of 2.96Å. Two of the neighbors are atoms not bonded directly to the sulfur atoms. The whole system of anions forms hydrogen bonds of two kinds. The first is of $\text{N} \dots \text{H} \dots \text{O}$ type and has a length of 2.90Å. These bind the tetrahedra in two-dimensional sheets. The second is of type $\text{O} \dots \text{H} \dots \text{N}$ and has a length of 2.86Å. These serve to connect the sheets in a three dimensional network. The structure is discussed and compared to other similar compounds containing the same atoms and arrangement.

The crystal structure of hydroxylamine-O-sulfonic acid, $\text{H}_2\text{NOSO}_3\text{H}$, was partially determined from Weissenberg and precession data. Photographs showed orthorhombic symmetry with cell dimensions $a = 6.39$, $b = 10.72$, and $c = 5.05\text{\AA}$. There are four molecules in the unit cell. The probable space group is $P2_1/n$. The higher pseudo-symmetry arises from crystals which are twinned along (001). The sulfur atoms were located by Patterson methods and the remaining atoms were found through trial and error procedures. Refinement of data was carried out by two-dimensional Fourier syntheses on (001) and (100). Final parameters are still in error for some atoms but the structure is substantially correct. The sulfur atom is surrounded by the four oxygen atoms in a very distorted tetrahedra. The nitrogen atom is bonded to one of the oxygens in the tetrahedra. The S-O distances are 1.34, 1.36, 1.52, and 1.62Å, while the N-O bond is of length 1.36Å. The longest S-O bond involves the oxygen which has an attached nitrogen. Hydrogen bonds of length 2.58Å connect two molecules in a dimer-like arrangement and ones of length 2.70Å unite the structure in three dimensions. The formation of dipolar ions of the type $\text{H}_3\text{N}^+\text{SO}_4^-$ may be possible but was not confirmed by the present data. The molecule is discussed in terms of bond distances and relative stability.

81 pages. \$1.50. Mic 56-2498

THE RELATIVE EFFICIENCIES OF
THE ISOMERIC BUTENES IN THE
REMOVAL OF FREE METHYL RADICALS

(Publication No. 18,322)

Robert Vincent Einstman, Ph.D.
The University of Connecticut, 1956

Many reports in the chemical literature cite the differences in the inhibitory effects of propylene and nitric oxide on thermal decompositions of compounds that decompose by free-radical mechanisms. In an effort to obtain a better understanding of these differences and to provide some further insight into the general nature of olefin inhibitors, this investigation of the inhibitory effects of the three isomeric butenes on the thermal decomposition of dimethyl mercury was undertaken.

Dimethyl mercury was thermally decomposed in the presence of isobutylene, butene-1, and butene-2 to determine the effects of these olefins on the rate and the products of the reaction. A static system was employed and mercury-cutoff stopcocks were used to isolate the reaction vessel from the rest of the system. The rates of decomposition were measured manometrically. Reaction products were analyzed by three independent methods, namely, by the Bone-Wheeler technique, by vapor phase chromatography, and by mass spectrometry.

Of the three butenes, isobutylene was found to be the best inhibitor, causing an inhibition of about 60% in the decomposition rate. Butene-1 inhibited the decomposition by about 43%. Butene-2 was found to be the poorest inhibitor, producing an inhibition of only about 10% in the rate of decomposition. In each case, the amount of inhibition was dependent on the initial pressure of dimethyl mercury. This implies that the inhibitor is reacting with some intermediate that can also react with dimethyl mercury. In this way, the competition between the dimethyl mercury and the inhibitor for reaction with the intermediate is responsible for the pressure-dependency of the inhibition.

The activation energies for the three inhibited decompositions in the presence of isobutylene, butene-1 and butene-2 were determined. In all three cases, the activation energy for the inhibited decomposition was slightly less than that for the uninhibited decomposition. This implies that the efficiency of the inhibitor increases with increasing temperature.

The gaseous products of both the uninhibited and the inhibited decompositions consisted only of methane and ethane. The ratio of methane to ethane in the reaction products increased slightly as the efficiency of the inhibitor increased.

On the basis of the observed results, it was concluded that the butenes inhibit the thermal decomposition of dimethyl mercury by reacting with methyl-radical chain carriers to produce methane. Possible mechanisms for this process have been proposed.

92 pages. \$1.50. Mic 56-2499

CHRONOPOTENTIOMETRIC ANALYSIS IN FUSED
LITHIUM CHLORIDE-POTASSIUM CHLORIDE

(Publication No. 18,134)

William Sidney Ferguson, Ph.D.
University of Illinois, 1956

The chronopotentiometric method of chemical analysis was investigated in a solvent of lithium chloride - potassium chloride eutectic mixture at 450° C using cadmium chloride as a model solute. Five different platinum microelectrodes were used to study the reduction of cadmium(II) to cadmium metal. To a good approximation the mass transport was solely by linear diffusion to two of the electrodes, one being a wire 1.024 mm. diameter by 2.691 mm. long and the other being a rectangular piece of foil 2.785 mm. by 3.133 mm. The diffusion to three other electrodes of smaller dimensions was found to be complicated by detectable degrees of non-linear diffusion into the linear diffusion field. The deviations of these three electrodes were examined and shown to be a consequence of their dimensions being too small for their surfaces to approximate large planes relative to the distance from which cadmium(II) was diffusing to the surfaces.

Using the two largest electrodes the feasibility of chemical analysis for cadmium chloride in the fused salt solvent was demonstrated over the concentration range 0.70 to 26.6×10^{-4} mole fraction of cadmium chloride. A recording potentiometer was used in conjunction with a DC amplifier to measure transition times between 0.7 and 5 seconds with a standard deviation for the square root of the transition time of $\pm 2.0\%$. The diffusion coefficient of cadmium(II) in the eutectic solvent at 450° C was calculated upon the basis of the experimental data to be $1.96 \times 10^{-5} \text{ cm}^2 \text{ sec}^{-1}$.

Several techniques which represent contributions to the methodology of fused salt research are described. A cell design is given which incorporates the features of simple Pyrex glass construction, capability of operation either under vacuum or controlled atmosphere, several separate but electrolytically connected compartments in which different experiments can be carried out during the course of a single experimental run, and easy manipulative access to all cell components. The cell was found useful for carrying out general chemical reactions in the fused salt solvent as well as for electrochemical work. A nonpolarizable platinum foil-platinum(II) reference electrode is described the design of which is rugged enough to permit storage at room temperature after an experiment and reuse in subsequent experiments. A practical method was given for the preparation of the fused salt solvent which prevents hydrolytic decomposition during the fusion yielding a melt suitably pure for microelectrode work.

67 pages. \$1.50. Mic 56-2500

SQUARE WAVE TITRIMETRY

(Publication No. 18,145)

Larry Cully Hall, Ph.D.
University of Illinois, 1956

A new way of detecting end points electrometrically has been developed. The method measures the slope of

current-voltage curves at the null potential and is essentially the a.c. analogue of the Willard-Fenwick and Foulk-Bawden methods. The method involved the application of a square wave voltage of low frequency to a pair of identical micro electrodes in solution. When the voltage was very large (55 v) and was applied to the electrodes through a large resistance (5 meg ohms) a small constant current flowed through the system. When the potential drop across the electrodes was measured a large potential was obtained for irreversible redox systems and a small potential drop for reversible redox systems. This procedure was the analogue of the Willard-Fenwick method. If a small, constant voltage (20 to 40 m.v.) was applied to the electrodes a current, as measured across a standard resistor, flowed. A reversible electrode reaction produced a large current while an irreversible electrode reaction produced a small current.

Theoretical equations were developed which described the response of the slope of the current-voltage curves at the null potential when the electrode reaction was reversible, irreversible or partly controlled by electron transfer and mass transfer. A critical study was made on the iodine-iodide system. It was found that when a low frequency, a small, constant applied signal and a low value of external resistance were used a steady state condition was achieved for the current. The constant current method was found to be limited because the capacity associated with an electrode in solution distorted the square wave function. A second limitation was that the constant current which flowed through the electrodes had to be very small in order not to produce an error for dilute solutions. When the current was small enough to eliminate the error, the change in the potential drop across the electrodes during a titration was small and difficult to measure.

Dilute iodine solutions of the order of $5 \times 10^{-6} M$ were successfully titrated with arsenite using both the constant applied potential and the constant current methods. The square wave method was estimated to be ten times more sensitive to dilute iodine solutions than the conventional amperometric method.

The argentometric determination of $6.7 \times 10^{-3} M$ chloride, bromide and iodide individually showed the constant current method to be comparable with the amperometric method. The square wave method gave better results than the amperometric method for $6.7 \times 10^{-3} M$ mixtures of chloride and bromide or chloride, bromide and iodide. For these mixtures the square wave method gave results that were within 1% of the theoretical amount and had a standard deviation of no more than 0.044.

A solution of $10^{-2} M$ potassium cyanide was determined with silver nitrate using the constant applied potential method. The results showed a standard deviation between 0.009 and 0.025 and an average deviation from theoretical of 0.0 to +0.71%. The same accuracy and precision was obtained whether ammonia was present or not.

Finally, ferrous ammonium sulfate and ferrocyanide were determined in a chloride and sulfuric acid medium using both the constant current and constant applied potential methods. The titration curves that were obtained were in agreement with those predicted from theory. The standard deviation was between 0.012 and 0.058 while the deviation from the theoretical result was from +1.2 to +0.1%.

118 pages. \$1.50. Mic 56-2501

AN INVESTIGATION OF THE COMPRESSIBILITY FACTORS OF GASEOUS MIXTURES OF CARBON DIOXIDE AND HELIUM

(Publication No. 17,232)

Robert C. Harper, Jr., Ph.D.
University of Pennsylvania, 1956

Supervisor: Dr. J. G. Miller

An investigation of the compressibility factors for gaseous mixtures of helium and carbon dioxide was performed at 30°C using the Burnett procedure. The pressure measuring system was modified to incorporate a visual high pressure oil manometer as the null indicator. Results were expressed in an empirical regression formula from which approximations to the second virial coefficients could be obtained. An argument is advanced that the analytical procedure used is superior to the usual methods of expressing compressibility data. The mixing rule of Lennard-Jones and Cook for second virial coefficients in binary gas systems was found to give a consistent explanation of the results. The interaction coefficient characteristic of bimolecular encounters between helium and carbon dioxide molecules was determined and found to be in reasonably good agreement with the value calculated by Lunbeck and Boerboom.

52 pages. \$1.50. Mic 56-2502

FLUORESCENCE AND SCATTERING OF LIGHT BY PLANT PIGMENTS

(Publication No. 18,165)

Paul Henry Latimer, Ph.D.
University of Illinois, 1956

This dissertation includes studies of two phenomena, carried out because of their relation to the problem of energy transfer in photosynthesis. The initial objective was to measure the quantum yields of fluorescence of photosynthetically active pigments. In the course of testing the apparatus designed for this purpose, a hitherto unnoticed spectral selectivity in the scattering of light by pigmented algal cells was found and investigated.

(1) The quantum yields of fluorescence were measured using the integrating sphere technique. The following table includes some of the results.

Pigment	Solvent or Organism	Quantum yield of fluorescence ^(a)
Fluorescein	aq. NaOH	91%
Chlorophyll <u>a</u>	ether	33%
Chlorophyll <u>a</u>	Chlorella (green alga)	2.7% ^(b)
"	"	1.7-2.0% ^(c)
"	Navicula (diatom)	2.8% ^(b)
"	Synechocystis (blue-green alga)	1.5% ^(b)
Phycocyanin	phosphate buffer	53%
Phycocerythrin	phosphate buffer	85%
Phycocyanin	Synechocystis (blue-green alga)	3.0-3.5%

(a) Extrapolated to infinite dilution to correct for self-absorption of fluorescence.

(b) Excited with 50 ergs/cm² sec., exc = 436mμ.

(c) Extrapolated to very low intensities of exciting light.

The quantum yield of fluorescence of algae, which was previously known to increase with the intensity of the exciting light at photosynthesis-saturating intensities, was found to vary with intensity also at low intensities. The yield of fluorescence at compensation of respiration by photosynthesis was found to be about 50% higher than the extrapolated value for very low intensities of the exciting light.

(2) To measure the wave length dependence of scattering of light by algal cells, suspensions were illuminated with monochromatic light from a grating monochromator. The intensity of light scattered at 90° to the incident beam was measured with a photomultiplier tube. The intensity of scattered light at each wave length was divided by that of the incident light (measured by replacing the cell suspension with a MgO surface). Corrections were made for the attenuation of the incident and scattered beams by the suspension, and for fluorescence.

Sharp maxima in the scattering were found on the long wave length side of the absorption bands. The scattered light has two sources: (1) colorless cell structures, which scatter with a relatively uniform wave length dependence, (2) highly pigmented particles (chloroplasts or grana), which scatter with a strong spectral selectivity. The capacity of a particle to scatter light should in fact increase with the index of refraction, which passes through a maximum on the low frequency side of an absorption band. This is where the scattering maxima were found.

Since the intensity of selective scattering depends on the size of the colored particles and the packing of pigment molecules in them, it appears that studies of this effect may provide information about the arrangement of pigment molecules in the living cell.

141 pages. \$1.90. Mic 56-2503

THE KINETICS AND MECHANISM OF THE THERMAL DECOMPOSITION OF GASEOUS METHYL ISOPROPYL KETONE

(Publication No. 18,330)

Peter Lott, Ph.D.

The University of Connecticut, 1956

The thermal decomposition of methyl isopropyl ketone was studied in a static manometric system between the temperatures of 505°C and 575°C . The decomposition was a homogeneous reaction and followed first order kinetics. Increasing the surface to volume ratio sixfold, decreased the rate 17%. Addition of foreign gases to the reaction like ammonia, hydrogen cyanide, water vapor, and carbon monoxide had no marked effect on the decomposition rate, while addition of nitric oxide catalyzed the reaction. Propylene acted as an inhibitor and the amount of inhibition, for a fixed concentration of propylene, was dependent on the initial ketone pressure.

Activation energies were determined for the uninhibited reaction; and for the reaction in the presence of propylene, and nitric oxide, as well as for nitric oxide - propylene mixtures. The results are tabulated as follows.

ACTIVATION ENERGIES FOR THE DECOMPOSITION OF METHYL ISOPROPYL KETONE UNDER VARIOUS CONDITIONS

Conditions	Activation Energy in kcal.
Uninhibited reaction (100 mm. ketone)	73.8
Inhibited -(110 mm. C_3H_6 + 100 mm. ketone)	68.9
Catalyzed -(25 mm. NO + 100 mm. ketone)	59.4
Catalyzed -(50 mm. NO + 100 mm. ketone)	59.1
Catalyzed -(25 mm. NO + 110 mm. C_3H_6 + 100 mm. ketone)	57.4
Catalyzed -(50 mm. NO + 110 mm. C_3H_6 + 100 mm. ketone)	58.4

Gas analyses were done at various times throughout the decomposition and showed that ketenes were formed as intermediates; and that the products of the reaction were predominantly methane, carbon monoxide, and propylene with smaller amounts of ethylene, ethane, carbon dioxide and hydrogen. The relative percentages of the products remained constant throughout the initial stages of the reaction, and the percentages of the products did not change appreciably either for the nitric oxide catalyzed reaction, or for the propylene inhibited decomposition.

On the basis of the experimental data, a short chain, a long chain, and a molecular mechanism were proposed for the pyrolysis.

Explanations for nitric oxide catalysis and propylene inhibition were suggested.

105 pages. \$1.50. Mic 56-2504

ACID AND BASE CATALYSIS IN THE SOLVOLYSIS OF ALKYL BORATES

(Publication No. 17,624)

Gilbert Thornton Perkins, Ph.D.

University of Virginia, 1956

The transesterification of alkyl borates with alcohols in the presence of a catalytic amount of sulfuric acid has been used as a method of preparing alkyl borates. The purpose of this work was to determine the rates with which certain alkyl borates react with ethanol and methanol, and to determine the effect of various catalysts on the rate of ester interchange.

The rates of reaction of *n*-butyl, isobutyl, isopropyl and *sec*.-butyl borates with ethanol were studied dilatometrically at 0° and 25°C , and it was found that *n*-butyl and isobutyl borates react immeasurably fast, isopropyl borate reacts with a fast but measurable rate, and *sec*.-butyl borate reacts still more slowly. The rate of ethanolysis of *tert*.-butyl borate was studied by hydrolyzing the ethyl borate formed and titrating for boric acid; this reaction goes very slowly. The methanolysis of *sec*.-butyl borate was studied, and found to be faster than ethanolysis.

In an attempt to determine which of the three steps in the transesterification is rate-controlling, a mixture of boric esters of ethyl and *sec*.-butyl alcohols was subjected to ethanolysis. A large volume change was observed at the beginning of the run, and then the rate of ethanolysis of *sec*.-butyl borate was observed. This indicates that the replacement of the first *sec*.-butoxy group is rate-controlling.

Any reaction which is catalyzed only by the conjugate acid (or base) of the solvent is said to be specific acid-(or base-) catalyzed, while a reaction which is catalyzed by undissociated acids or by bases other than the conjugate base of the solvent is said to be general acid-(or base-) catalyzed. The condition for general acid-base catalysis is that the reaction rate constant be proportional to the concentration of all the catalytically active species present in the solution. Both general acid and general base catalysis was observed in the ethanolysis of *sec.*-butyl borate, the reaction being accelerated by acetic acid, hydrochloric acid, ethoxide ion, acetate ion and water. In the case of catalysis by acetic acid the rate constant was found to be proportional to the acetic acid concentration, but in the hydrochloric acid catalyzed reaction the rate constant was more nearly a linear function of the activity of hydrochloric acid, indicating an equilibrium between hydrogen ion and some other species in the solution, since in such a case the concentration of hydrogen ion would depend on its activity coefficient, and activity would enter the kinetics. The base-catalyzed reaction was not nearly as simple and straightforward as the acid-catalyzed reaction. In the case of catalysis by ethoxide ion the rate constant was found to vary with the borate concentration as well as with the catalyst concentration due to some interaction of ethoxide ion with the borate. In the acetate ion catalyzed reaction the relationship between the rate constant and acetate ion concentration is not linear, and the nature of the curve suggests that the acetate ion may be solvolyzed to acetic acid and ethoxide ion which in turn act as catalysts. In the case of catalysis by water the relationship between the rate constant and water concentration is again not linear, but this may be attributed to a medium effect. Catalysis by acetic acid-lithium acetate buffers showed that the lithium acetate and acetic acid act as catalysts independently of each other.

The hydrochloric acid catalyzed ethanolysis of *tert.*-butyl borate was studied, and the rate constant was found to be proportional to the hydrochloric acid concentration.

72 pages. \$1.50. Mic 56-2505

THE ELECTRON DYNAMICS OF
THE PEPTIDE LINKAGE
THE POLARIZED SPECTRUM OF
THE MYRISTAMIDE CRYSTAL

(Publication No. 17,140)

Don Lee Peterson, Ph.D.
University of Washington, 1956

In order to measure the polarizations of transitions to excited electronic states in the amide group, spectra were taken of very thin, single crystals of myristamide between 1600 and 2300 Å. A separate spectrum was obtained corresponding to each of the two extinction directions in the (001) face. The orientation of the transition moment for each electronic band observed is inferred from the crystal spectra. This involves a consideration of the effects of intermolecular interaction in the crystal on the electronic spectrum. The nature of the produced effects depends on the strength of intermolecular coupling compared to the frequency of molecular vibrations. A method for deter-

mining coupling strength is given. Three electronic bands are identified in the crystal spectra and classified according to simple orbital theory. Two of these bands have been previously assigned as NV_1 and $n-\pi$. The third is assigned as a Rydberg transition. The long-wavelength side of a fourth band, believed due to an NV_2 transition, is observed. The transition moment direction of each band is ambiguously determined as either of two possibilities. A choice is made possible in the case of the NV_1 transition by using a measurement of the polarization direction in crystalline N,N' -diacetylhexamethylenediamine and further by measurements on crystalline N -acetylglycine of Ward. The implications of the measured NV_1 transition moment direction with regard to the electronic structure in the ground state of amides is considered. It is concluded that the localization of the amino nitrogen lone pair is only slight in myristamide.

93 pages. \$1.50. Mic 56-2506

THE PROPERTIES OF ELECTROLYTES
IN ANISOLE-NITROBENZENE SOLUTIONS

(Publication No. 18,086)

Arnet Lauriston Powell, Ph.D.
Clark University, 1956

Supervisor: Arthur E. Martell

The effect of dielectric constant upon ion association for tetraethylammonium and tetra-*n*-butylammonium picrates in mixtures of anisole (dielectric constant = 4.30) and nitrobenzene (dielectric constant = 34.9) was investigated by means of conductance measurements. Limiting conductances at infinite dilution and dissociation constants were evaluated with the aid of the Shedlovsky equation for solvent mixtures with a dielectric constant ≥ 10 , and by means of Walden's rule and the Ostwald dilution law for media with dielectric constant < 10 . Walden products ($\Lambda_0\eta_0$), ion sizes, and free energies of dissociation were computed for each solution of each quaternary ammonium salt.

For each electrolyte, increasing ion association with increasing anisole content was indicated by progressively steeper conductance curves and gradually decreasing dissociation constants. Ion sizes, "a," computed from the Bjerrum theory were not constant for each solute, but varied with composition of solvent. Application of the Sadek-Fuoss model which involves use of the continuum theory for longer interionic separations and describes expulsion of the last layer of solvent molecules between an incipient pair by a separate mass-action constant, resulted in an approximately constant value of "a" for each electrolyte. Insertion into the Bjerrum equation of the ion size, determined in this way for each quaternary ammonium picrate, made it possible to reproduce dissociation constant as a function of dielectric constant reasonably well. Free energies of dissociation calculated for each solution of each solute tended to approach the thermal energy of the molecules at 25°C., as ionization became complete.

The variation of ion association with dielectric constant of tetraethylammonium and tetra-*n*-butylammonium picrates in a non-aqueous, aprotic solvent medium

(anisole-nitrobenzene) is similar to that reported by Fuoss and Kraus for tetraisoamylammonium nitrate in an aqueous, protonic medium (dioxane-water). Dissociation constants for the same dielectric constant were higher for the aqueous system than for the two non-aqueous cases. This relationship can be ascribed to differences in the sizes and constitutions of the ions of the solutes involved and to variations in solvation. The more complete dissociation of tetra-n-butylammonium picrate than of tetra-ethylammonium picrate in the anisole-nitrobenzene mixtures is in accord with the larger size of the former cation and the resultant greater distance between the centers of positive and negative charge. The critical dielectric constants (above which there is no ion association), determined by extrapolation of the experimental curves, agree quite well with the corresponding values computed by use of the Sadek-Fuoss model and the Bjerrum theory.

Physical properties such as density, viscosity and dielectric constant vary smoothly with composition of the solvent. The fact that Walden's rule holds approximately for both systems investigated indicates that ion sizes should be invariant. Nevertheless, ion sizes calculated from experimentally determined dissociation constants by use of the Bjerrum equation vary with the make-up of the solvent mixture.

There are two possible explanations which may be advanced to account for these facts. The first, that solvation of ions and ion pairs changes with composition of the solvent mixture, is in agreement with the observed increase of effective ion size with rising anisole content. The second explanation involves the assumption that the macroscopic dielectric constant does not hold for molecular distances of approach of two ions to form an ion pair.

The results of this research indicate that variation in ion size with changing dielectric constant cannot be attributed to experimental error. It is much more likely that the mean diameter of the solvated ions cannot be expressed precisely by the Bjerrum theory, and that some modification such as that of Sadek and Fuoss must be applied.

100 pages. \$1.50. Mic 56-2507

MOLECULAR ORBITAL STUDIES OF CHLORINE SUBSTITUTED METHANES

(Publication No. 17,201)

Joseph Dewey Robinson, Ph.D.
Washington University, 1956

Chairman: Lindsay Helmholtz

Approximate molecular orbitals made up of linear combinations of self-consistent field atomic orbitals of hydrogen, carbon and chlorine have been determined for carbon tetrachloride, chloroform and methyl chloride. Values of quadrupole coupling constant and dipole moment calculated from these molecular orbitals are compared with experimental data. 42 pages. \$1.50. Mic 56-2508

INTERACTION OF INORGANIC MACROMOLECULAR SYSTEMS WITH SURFACE ACTIVE AGENTS

(Publication No. 17,281)

Harold O. Strange, Ph.D.
University of Pennsylvania, 1956

Supervisor: Dr. J. Fred Hazel

The purpose of this investigation was to describe and study systematically the effect of ionic surface active agents on the electrokinetic properties of inorganic macromolecules, and to determine the relationships between the stability and the electrophoretic mobility, and the chain length and type of surface active agents.

The experimental methods used were the flocculation studies of various surface active agent and inorganic colloid mixtures, and determination of electrophoretic mobilities of the colloids and the streaming potentials of solid surfaces of the same materials in the presence of various amounts of surface active agents. The colloidal suspensions used were positively charged ferric and aluminum oxides and negatively charged manganese dioxide and arsenic trisulfide, all in aqueous media. The surface active agents used were potassium fatty acid salts and sodium n-alkyl sulfates as anion active agents, and n-alkyl pyridinium and amine chlorides, as cation active compounds.

Flocculation studies indicate that the concentration of surfactant required to just cause complete precipitation of the colloids (the flocculation value) decreases sharply with increasing chain length, in the case of a positive sol with anionic agents and negative sols with cationic agents. In the reverse case of a positive sol and cationic agent and a negative sol and anionic agent, the flocculation values are much higher and are independent of the chain length. Hydrolysis of the surfactant was found to be of negligible importance in these systems. At higher concentrations of surface active agent a restabilization of the colloid was observed, which was attributed to a recharging of the colloid particles. An extensive discussion of an adsorption mechanism to explain the observed results has been given. The electrophoretic mobility of the colloid particles was decreased with increasing concentration of surface active ions of opposite charge, with the colloid eventually becoming oppositely charged, supporting the flocculation results. Streaming potential studies also supported these observations. The mobility is decreased to a greater extent for the same concentration of surfactant with an increase in the chain length. The logarithm of the isoelectric concentration (the concentration of surfactant which causes the particles to cease to migrate) plotted against the chain length gave straight lines for each homologous series, which were parallel for the same colloidal suspension. This agrees with the results for plots of the logarithms of the critical micelle concentrations of the surfactants versus chain length. This is closely related to the known adsorbability of the surface active ions used. Plots of the logarithms of the flocculation values versus chain length also tended to straight lines with the more dilute sols studied.

The critical micelle concentrations of the various surfactants were determined by the equivalent conductivity method, agreeing with the results of other investigators. These studies indicate that the critical concentration is

increased when an increasing amount of inorganic colloid of opposite charge is added to the solution. This increase is attributed to removal of the surfactant from solution due to adsorption by the colloid.

The conclusions of this study are that the stability of inorganic aqueous suspensions is markedly dependent on the chain length of the surface active ion of opposite charge, and that the electrokinetic properties are similarly affected by increasing chain length. These studies along with the critical micelle concentration studies indicate that the major phenomenon involved in these systems is the adsorption of the surface active ion by the colloid particles possessing a charge opposite that of these ions.

169 pages. \$2.25. Mic 56-2509

THE DECOMPOSITION OF FORMIC ACID VAPOR ON EVAPORATED NICKEL FILMS

(Publication No. 17,406)

Dean Kirkland Walton Ph.D.
The Ohio State University, 1956

The rate of decomposition of formic acid vapor on nickel films has been studied in a static system from 125 to 190° C. and from 10 to 50 mm. pressure.

The films were prepared by evaporation of 10 to 100 mg. of nickel in a spherical 500 ml. Pyrex flask having an internal surface of 300 cm.², followed by sintering at 190° C. The evaporations were carried out both in a high vacuum and in 1 to 2 mm. of nitrogen. The average crystallite size, as determined by x-ray measurements, was 270 Å. for the high vacuum films and 160 Å. for the nitrogen type of films. Electron diffraction studies showed that both the high vacuum-evaporated and the nitrogen-evaporated films were randomly oriented on both soft- and Pyrex-glass backing, and that after use, the high-vacuum films had an unidentified amorphous substance on the surface. Samples made when the flask was not thoroughly degassed before evaporation showed nickel oxide lines.

The surface area of the films sintered at 190° C. was determined by measuring the amount of hydrogen rapidly chemisorbed at 0° C. The surface areas were reproducible. They showed a decreasing increment as the amounts of nickel were increased up to 100 mg. For the same weight of nickel, the nitrogen-evaporated films have four

times the area of the high vacuum films. The catalytic activity per unit surface area is the same for the two types.

The products of decomposition — hydrogen, carbon dioxide, carbon monoxide, water vapor, and methane — were identified by mass spectrographic analysis; no other gases were detected. Hydrogen, carbon dioxide, and carbon monoxide were measured by gas analysis, and the small amount of methane (< 1 per cent) was determined from mass spectrograms. Water vapor was determined indirectly and was found to be present in amounts equal to the amount of carbon monoxide formed. The ratio of carbon dioxide to carbon monoxide is constant at about 3 to 1 throughout the main course of a single reaction and at all the temperatures studied.

No reaction occurred at 190° C. in the absence of a nickel film.

The initial rate of decomposition of formic acid vapor on evaporated nickel films is zero order with respect to the formic acid pressure. The rate decreases with time in individual experiments.

Observation at different temperatures indicates that there is no difference between temperature coefficients of reactions on the high vacuum-type and nitrogen-type nickel films; the activation energy for the combined data is 16.5 ± 1.3 kcal./mole.

The addition of a product gas causes the initial rate to decrease inversely with the pressure of the added gas. The general shape of all the curves, giving pressure increase with time, is similar for all the experiments in which product gases are added except for carbon dioxide, which acts as a strong poison after the first few minutes of the reaction. Oxygen is a strong poison for the reaction.

The degree of degassing, before and during the evaporation of nickel, affects the initial activity of the films. Films evaporated at 10⁻⁷ mm. are about 2 to 3 times as active as those evaporated at 10⁻⁶ mm.

The first decomposition experiment on a nickel film has the highest initial rate. The initial rates of the slower subsequent decompositions on the same film depend upon the evacuation pressure reached between experiments, i.e., the initial rate is smaller when the flask is evacuated to 10⁻⁶ mm. between experiments than when evacuated to 10⁻⁵ mm.

The mechanism is discussed, and an inhibited bimolecular surface reaction with a formate-like intermediate is suggested.

232 pages. \$3.00. Mic 56-2510

ECONOMICS, GENERAL

THE LIQUIDITY STRUCTURE OF
LIFE INSURANCE COMPANIES

(Publication No. 17,239)

Jack Cutler Keir, Ph.D.
University of Pennsylvania, 1956

Supervisor: Harry J. Loman

The liquidity structure of a life insurance company should be thought of as the capacity of the company to meet its maturing obligations. To measure the strength of the liquidity structure of a life company therefore necessitates a determination of the availability of cash relative to the need of the company for cash. This determination was the purpose of the thesis.

With respect to both the availability of and the need for cash there are several factors favoring the life companies. First, the maturity of their obligations occurs slowly over a long period of time in a predictable and uniform manner. Second, the cash inflow from premium volume and investment income remains stable in spite of fluctuations in employment and Nation Income. Third, the demand for policy loans and cash surrender values are normally unimportant relative to the annual cash inflow.

There were two periods in life insurance history during which the cash outflow to policyholders and beneficiaries was unusually large.

(1) Influenza Epidemic 1918-1919 - In spite of the great increase in the death rate and in spite of concentration during a few months and among policyholders at the younger ages, the life companies weathered the epidemic with little distress. Moreover, the influenza epidemic gave recognition to one of the previously seldom used sources of liquidity -- ability to borrow. For example, nine companies operating in New York state borrowed a total of \$154,419,000 during 1918 and \$50,175,000 during 1919.

(2) The Depression Years of the Early 1930's - The greatest challenge to the capacity of the life companies to meet their contractual obligations was the period of the "great depression" of the 1930's. During this period the out flow of funds to meet the demand for policy loans and cash surrender values was truly enormous. For a group of 48 companies representing 86.4 per cent of admitted assets of all legal reserve life insurance companies in the United States, cash policy loans were \$2,048,678,000 and cash payments to surrendering policyholders were \$1,414,252,000 for the period 1930 through 1932. For the seven-year period 1930-1936 these payments were nearly 48 per cent of the companies' 1930 liabilities.

In spite of this tremendous out flow of cash during the early 1930's the life companies as a whole met the demands for cash with little need to liquidate portfolio assets. The stability of the cash inflow of the life companies is impressively emphasized by this depression experience.

Assuming a future depression whose severity would necessitate a demand for cash values twice as great as that existing in 1932, the group of 14 companies studied would have to liquidate less than 10 per cent of their portfolio assets to meet cash outflow requirements. Moreover, if conditions of financial stringency should ever reach such severity in all probability the federal government would impose a moratorium on the payment of cash values as it did in 1933. With the current volume of U. S. Government securities in the investment portfolio of life companies adequate provision for the demand for cash values appears assured.

Although it appears that the liquidity structure of the life companies is wholly adequate to cope with a severe economic depression the companies should recognize that there have been some developments both internally and externally which might increase the need for portfolio liquidity above the need in the 1930's.

Among the internal factors we should note: (1) The increased writing of group insurance whose existence might encourage the policyholder to surrender the higher premium ordinary since by so doing the policyholder reduces his premium payments and also obtains the much needed cash value of the ordinary. (2) A considerable part of the funds directed to life insurance these days is considered by policyholders as demand deposits which in case of need can be drawn out. (3) The lower interest rate assumed by the companies in writing their contracts has increased the reserve values and therefore the cash values per \$1000 of insurance in force. (4) The increased use of settlement options leaves funds with the companies which may be demanded in most cases at anytime. (5) The tremendous growth in conventional group annuities has produced a potentially important liquidity problem for some companies because of the demand for cash values by employees whose employment might be terminated in a depression and because of the cashing out of Deposit Administration Plans by employers. (6) In recent years there has been an increase in the use of the prior investment commitment by the companies so at anytime there is an obligation to pay out to business firms over the next few months considerable sums of cash.

Among the external factors which might increase the need for portfolio liquidity we should note: (1) The increased propensity of the public at large to borrow, (2) confidence on the part of the public in the ability of the Federal Government to make any down turn in economic activity of short duration and this confidence might encourage the public to borrow on their life insurance, (3) the magnitude of outstanding bank loans with life insurance policies pledged as collateral, (4) the existence of National Service Life Insurance and survivorship benefits under Social Security might encourage the surrender of the higher premium ordinary life insurance in a period of depression.

350 pages. \$4.50. Mic 56-2511

UNION SECURITY IN FLORIDA INDUSTRIES UNDER THE RIGHT-TO-WORK AMENDMENT

(Publication No. 17,552)

John William Lowe, Ph.D.
The University of Florida, 1956

In 1944, Florida prohibited all forms of union security when the voters of the state gave overwhelming approval to a so-called Right-to-Work Amendment to the Florida Constitution. This Amendment clearly made any method of employer preference to unions illegal. The enactment of Right-to-Work legislation in many other non-industrial states has been followed by considerable controversy regarding the practical operation of these bans on union security.

The purpose of this study was to determine the extent to which employers have continued union security arrangements under the Right-to-Work Amendment and to investigate the adjustments which have been made to the legal restrictions. The study considers first the legislative and court history of the Amendment. This is followed by a report on the construction of a mail questionnaire and an analysis of the response. Answers to specific questions concerning hiring practices in the questionnaire provided the basis for further investigation of hiring practices in particular firms. The individual firm practices which are reviewed as the final phase of this study are the result of personal interviews and extensive correspondence with business executives.

This study allows the drawing of some definite conclusions regarding the practical operation of the Right-to-Work Amendment in the State of Florida.

1. Exclusive hiring through unions has been continued in some Florida industries. Some firms report that this arrangement is the only practical solution to their hiring problems. In addition to the exclusive contracts, the maintenance of membership agreement is a common form of union security in some Florida industries.

2. Some Florida employers follow a policy of active encouragement of union membership among their employees. In some cases, employers believe that a neutral attitude toward union membership is an important aid to union membership drives. Generally, Florida employers seem to believe that any hiring practices which avoid the "letter of the law" do not constitute preference to unions. Strong unions with no active opposition from employers often have no difficulty in maintaining high union membership.

3. Business firms which cooperate with unions in their hiring practices usually do not desire or anticipate aggressive enforcement of the Right-to-Work Amendment.

In addition to an analysis of union-management hiring practices, this study also presents a broad view of the specific objections which Florida employers have to union security and unionism in general. These criticisms of unions and their objectives illustrate the factors which unions must take into account in order to make their security goals acceptable to employers.

206 pages. \$2.70. Mic 56-2512

CLERICAL AND OFFICE UNIONISM IN THE UNITED STATES: THE UNIT FOR COLLECTIVE BARGAINING

(Publication No. 17,247)

John Francis Lubin, Ph.D.
University of Pennsylvania, 1956

Supervisor: Gladys L. Palmer

The purpose of this study is to examine the question of what are "appropriate collective bargaining units" for clerical and office employees in the United States, to analyze in detail the history and effect of governmental labor policy in regard to this problem, and, in particular, to study the actions of Federal administrative agencies (especially those of the National Labor Relations Board) concerning such unit determinations and how such determinations have affected and might affect attempts to unionize clerical and kindred employees. The basic hypothesis tested is whether clerical and office workers can and should bargain collectively as a separate group or in a unit with other types of workers, and whether and in what way governmental action has influenced this consideration.

The analysis includes a study of the composition of the clerical work force and its relation to the total work force and a general analysis of clerical and office worker unionism and its relation to the labor movement. Most of the data are derived from a comprehensive analysis of the decisions of the National Labor Relations Board with regard to the unit for collective bargaining for workers in general, and for clerical and office workers in particular. Actions of predecessor boards to the National Labor Relations Board, several of the state boards, and the National Mediation Board are introduced for purposes of comparison.

Office and clerical unionism is an example of the effect of lack of structural planning by the American labor movement. Such unionism did not get under way to any significant extent until the 1930's. Many of the characteristics of clerical unions are based on this late start as compared to that of other occupational groups. Office unions, when established, were given a "residual" jurisdiction with no jurisdiction over clerical workers who had been previously assigned to other unions. Despite this allocation of jurisdiction, the fundamental problem of office unions is that their "job control" carries little economic power. They were given both "work" and "bargaining" jurisdiction in their charters, but they had considerable difficulty in enforcing such jurisdiction.

Perhaps the most important assistance that the "strictly" office and clerical workers' unions receive is from the National Labor Relations Board (and, perhaps, the National Mediation Board). In manufacturing, the National Labor Relations Board generally holds that manual and office workers have different interests in collective bargaining and excludes clerical employees from the bargaining unit of manual employees, but establishes them in their own separate unit if they wish. "Plant clerical" workers who do work that is closely related to production, have the same supervision as production workers, and work in the same environment are usually included in the production workers' bargaining unit. In non-manufacturing, office and clerical workers are generally placed in comprehensive units. On railroads and in the air transportation industry, the National Mediation Board also follows a

"separation" policy for clerical employees in meeting the unit criterion of "craft or class" of the Railway Labor Act.

The power given to Federal administrative agencies was intended to facilitate collective bargaining and not to provide the means for governmental interference in the internal structure and self-government of the American labor movement. But this did happen. The principles and criteria formulated for unit determinations involving clerical and office workers were partly a reflection of the kind and number of petitions brought for decision and, as a result, have been "negative" in nature. In the case of clerical workers and their unions, the union movement has, in effect, abdicated its structure-determining function to governmental administrative agencies. This consideration plus recent organizational changes and proposed campaigns for new members by American labor suggest that perhaps it is time to reconsider the necessity for and the form of the power to determine bargaining units now formulated in the law and administrative decisions under it.

305 pages. \$3.95. Mic 56-2513

THE GOVERNMENT AND ECONOMIC DEVELOPMENT IN INDONESIA, 1950-1954

(Publication No. 17,622)

John Paul Meek, Ph.D.
University of Virginia, 1956

This study undertakes an appraisal of the effectiveness of the government's policies since independence in promoting higher Indonesian per capita incomes. This, rather than "Indonesianization" in the sense of raising the position of nationals within the economy, is seen as the primary immediate objective by which specific policies must be evaluated.

The possible contribution income redistribution might make to higher incomes is examined and found to depend on its relation to development. The process of economic growth is discussed in terms of a simple expositional capital-output model which divides the factors affecting growth into those determining the rate of investment - the supply and demand for investible resources - and those relating to the productiveness of capital. The development of a general framework for the discussion of specific facets of the Indonesian case is completed with a treatment of the relevance of economic stability to the growth process.

A review of the importance to the economy of primary production and its reliance on export markets reveals a decline in the role of the export sector attributable to government policies adversely affecting foreign estates. The post independence performance of the economy is seen as supporting the view that diversification and development might be better served by a rolling emphasis moving from familiar lines of activity and public overhead investment to more ambitious industrial activities than a frontal assault on industrialization.

The operation of the plural economy in prewar Indonesia is seen as supporting the view that differentiating between the foreign, Chinese and indigenous sectors in policy formation is necessary if economic growth is not to accentuate the existing stratification along racial lines.

Recent Indonesianization policies appear to have produced an appreciable redistribution of income in favor of the Indonesian sector, but seem in need of reorientation to attack more effectively the basic problems of changing the country's present factor endowment through training personnel, stimulating entrepreneurs, raising the rate of saving and attracting these scarce factors from abroad.

The government's execution of its primary responsibility for raising the community's rate of saving and investment is considered sadly lacking because of its inability to curb its current expenditures in favor of investment. The importance of careful planning of current as well as capital outlays is stressed, as is the desirability of more conscious efforts to increase the intensity and efficiency of capital use.

The government's success in capturing a large part of the windfall profits of the Korean boom by export taxation is taken to indicate the likelihood that careful programming of government expenditures could lead to cushioning the impact of export fluctuations on economic stability and investment though such programming was notably absent in Indonesia in 1951. The belief that further inflationary financing will accelerate growth is seen to have little support in the evidence of the first years of independence. Finally, the view is expressed that a more careful definition is needed of the objectives of economic policy if the future is to bring purposeful movement toward their attainment.

360 pages. \$4.60. Mic 56-2514

GRIEVANCE ARBITRATION IN THE ANTHRACITE INDUSTRY

(Publication No. 17,289)

Stanley Young, Ph.D.
University of Pennsylvania, 1956

Supervisor: Dr. George W. Taylor

Statement of the Problem:

The hypothesis of this study is to analyze whether or not the grievance arbitration machinery in the anthracite industry reflects the philosophy, principles, attitudes and prejudices of the parties' collective bargaining relationship.

Method of Analysis:

The history of the anthracite grievance arbitration machinery was reviewed and interpreted.

Results:

The anthracite arbitration machinery was initiated in 1903 by a United States Strike Commission appointed by President Theodore Roosevelt to arbitrate an industry-wide strike that occurred in 1902. The coal operators and the union, the United Mine Workers of America, immediately modified the provisions of the 1902 Strike Commission and accepted a form of grievance arbitration that has remained essentially the same until the present.

The anthracite arbitration machinery has the following characteristics: 1) An industry-wide arbitration Board composed equally of representatives of management and union was established. A permanent Umpire whose deci-

sions are final and binding was appointed. 2) The authority of the Umpire and the Board was restricted to the literal interpretation of industry-wide and local agreements and to the preservation of those conditions of employment not covered by the labor agreement. 3) Terms of employment not covered by the industry-wide agreement were considered to be fixed and established and could only be changed by agreement between the parties. Economic pressure could be used at the colliery level to change established terms of employment during the term of the agreement.

The arbitration machinery as devised by the parties has reflected the parties' collective bargaining relationship. Local negotiations over terms of employment not covered by the industry-wide agreement were accepted because of the following collective bargaining characteristics of the parties: 1) an arm's length relationship, 2) a separation of economic power between local and district union officials, 3) the miner's antipathy toward the operator, 4) the ability of the operator to accept wage rate differentials between competing firms, 5) the costs of local strikes are not unduly burdensome to either party and 6) a militant local leadership. Literal interpretations of the industry-wide and local agreements by the Umpire derive from the arm's length relationship. The parties view the Umpire as a judge whose sole function is to define and protect their respective rights and benefits.

Conclusions:

On the basis of the historical experience in the anthracite industry, one can conclude that the arbitration machinery reflects the philosophy, principles, attitudes and prejudices of the parties' collective bargaining relationship.

What are the theoretical implications of this conclusion for those interested in the field of labor arbitration? One cannot assume a doctrinaire approach to arbitration. As collective bargaining relationships vary, so will arbitration systems. One cannot assume *a priori* that certain arbitration techniques must be universally applied to varied collective bargaining relationships. A second implication is that uniformities in arbitration techniques between industries can be attributed to similar collective bargaining relationships. Another implication is that labor arbitration must be viewed as a multi-functional, multi-procedural process. Union and management devise procedures and functions in response to their collective bargaining relationship--a relationship which may vary from industry to industry. Finally, certain arbitration techniques are more applicable and acceptable in certain collective bargaining relationships than in others. In the evaluation of an arbitration technique, managements and unions should select those techniques that can best be applied to their particular collective bargaining relationship.

117 pages. \$1.50. Mic 56-2515

ECONOMICS, COMMERCIAL BUSINESS

A STUDY OF THE MECHANISMS AND FUNCTIONING OF MANPOWER PLANNING

(Publication No. 17,464)

Kuo Chung Chen, Ph.D.
State University of Iowa, 1956

Chairman: Professor Walter L. Daykin

This study represents a type of research relative to the structural and mechanical aspects of manpower planning. By manpower (planning is meant the programing of manpower resources) with respect to conservation, utilization and allocation toward an over-all, far-reaching objective. In an industrially advanced country, the major objective of manpower planning is to help attain and or maintain full employment or maximum employment. In the economically less-developed areas, manpower planning aims to accelerate economic development.

Historical, empirical, and theoretical approaches are used in this study. For the study of the development of the manpower concept, the historical approach is employed. The exploration of various methods and mechanisms for manpower programs is accomplished mostly through the use of empirical methods. Theoretical analyses are generally applicable in the study of functions and operations of the measures being surveyed, particularly with respect to the implications and the impact upon the operation of the economic process as a whole.

There are four major areas of manpower programs which this study attempts to examine. They are the concepts and methods of manpower measurements, the characteristics of manpower resources, the conservation of manpower, and manpower allocation.

The basic requirement for measuring manpower is the establishment of a concept. Manpower concepts for measurement have undergone considerable changes during the last two decades. Prior to 1940, the measurement of manpower was based upon the "gainfully occupied" concept. Because the concept takes account of those who have or have had a usual occupation, it fails to measure adequately either employment or unemployment at a given time.

A new approach known as the "labor force" concept was developed to meet the need for comprehensive and current data on employment, unemployment and the labor force. Based upon the new concept, manpower is being measured in terms of its activities and the extent of its labor market participation.

A concept is a yardstick. To actually measure manpower, practical methods must be employed. The most comprehensive method based on the "labor force" concept is the monthly sample survey technique. This method has been officially used by the United States for sometime and is now being employed in Canada, Japan, and Puerto Rico. Featured by its low cost, high relative precision of result, and timeliness, this method promises to be the most useful technique yet devised for taking manpower inventory. Despite all the advantages, there is still room in this method for further improvement. The most vulnerable area in which improvement is needed is that of the measurement of under employment.

Manpower resources are one of the most stable stocks of a nation. The size of manpower resources depends pri-

marily upon the size of the population, and in the long run, the size of population is dependent upon the net reproduction rate. In the short run, the size of population does not vary materially. In the absence of major disturbances, such as war, the ratio of manpower or the economically active population to total population can be expected to remain at a fairly constant level.

The conservation of manpower resources in terms of physical protection and economic security has become an area of interest in the public policy programs throughout the world. The tendency for public intervention in the workers' welfare and social security to be broadened in many countries indicates the growth of an expanding institution.

The movement of manpower resources into, out of, or between occupations is conditioned by various structural, institutional and personal factors. The extent to which these factors may influence the allocation of manpower depends primarily upon the type of economic system in which these factors operate. Regardless of the differences between economic systems, manpower policies and programs are an integral part of public policy and may be used to bring about an effective allocation of manpower and a high level of employment.

348 pages. \$4.45. Mic 56-2516

A SITUATIONAL ANALYSIS OF THE SCOPE,
ORGANIZATIONAL STRUCTURE, AND FUNCTION
OF PERSONNEL RESEARCH IN
THE MANUFACTURING INDUSTRY

(Publication No. 17,158)

James Graham Jones, Jr., Ed.D.
Wayne University, 1956

Concentrated research programs directed toward the maximum utilization of human resources within industry are a fairly recent development. As a result, there is a scarcity of assembled data available to the researcher for study. The hypothesis was therefore established that by determining the current status of the personnel research function in industry, and by isolating trends that would be significant for planning purposes, it would be possible to establish a uniform approach to the development of personnel administration policies pertinent to this field.

Because of the scarcity of materials relating to industrial personnel research activities and the need for a wide variety of information a questionnaire survey approach was used to obtain the desired data.

A sample of 225 manufacturing companies, each representing a minimum capital outlay of over a million dollars with a minimum of 1,000 employees on the payroll, were considered for the study. Of this number, 123 manufacturers, representing more than two million employees presented data of their personnel research activities for study.

A preliminary analysis of the returns provided three categories into which the questionnaires could be classified. The first category consisted of those firms without a personnel research function, the second represented those organizations with a personnel research function crossing many organizational lines, and the third comprised those companies with a centralized function.

In the interest of clarity and ease of use, it was decided to present the results of the study as a situational analysis rather than in topic-centered form. This organization has an added advantage in that it would permit comparative relationships between the established categories.

On the basis of a situational analysis of the personnel research function in the manufacturing industry covering over two million employees it is found that:

- * Personnel research as a formal function is confined to the larger manufacturing enterprise with 25,000 or more employees. The predominant number of firms supporting an activity incorporated with other personnel responsibilities are in the range from one to ten thousand employees.
- * The director of the formal personnel research function has direct support of top management by reporting to a vice-president of industrial relations who is considered an integral part of top management. Although fixed within the industrial relations office, personnel research in the smaller industry is several echelons removed from the top and, by incorporation in a unit that provides several personnel services, loses its effectiveness as an integral activity of the organization.
- * The functions of both activities are compatible with those of any staff office. However, in the informal research activity direction is toward the more immediate operational problems.
- * Both groups are essentially college graduates, and although not academically prepared in the areas of industrial psychology or personnel management, feel a definite need for this type of experience in their respective organizations.
- * Consultants are used by both activities, but to a greater extent in the informal research activity to supplement a lack of professional help that is available in the established research function.
- * Personnel research in the manufacturing industry is essentially applied research concerned with specific human and organizational problems.
- * In the opinions of both the personnel research directors and those responsible for research along with other functions, management is aware of the importance of personnel research to company operations and the expansion and subsequent future of the function within industry is good.

In summary, the study has enhanced understanding, advanced knowledge, and created greater appreciation for the field of industrial personnel research.

150 pages. \$2.00. Mic 56-2517

**A CRITICAL ANALYSIS OF
CONTEMPORARY ACCOUNTING THOUGHT
ON CONSOLIDATED REPORTS**

(Publication No. 18,157)

Rodger Edward Karrenbrock, Ph.D.
University of Illinois, 1956

As indicated by its title, the general objective of this study is a critical analysis of contemporary accounting thought on consolidated reports. In seeking a cross-section of contemporary accounting thought, reference was made to accounting textbooks, accounting periodicals, the Internal Revenue Code, court decisions, regulations of the Securities and Exchange Commission, requirements of the New York Stock Exchange and similar sources. Considerable reliance has been placed upon the replies to a questionnaire relating to consolidated financial statements which the American Institute of Accountant's Research Department collected in 1955 as an indication of the thinking of contemporary industrial and public accounting practitioners.

The study has been directed toward a comparison and resolution of the array of alternative and sometimes contradictory and inconsistent procedures currently recognized by accountants in constructing consolidated reports. The conclusions derived are offered as a theoretically valid framework of consolidations accounting standards which possesses both practical and theoretical merit and which conforms to the most useful business entity concept of corporate combination.

The study includes an investigation in the following general areas: the objectives, limitations, and concepts of consolidated reports; criteria for consolidation; intercompany shareholdings; intercompany bond holdings; intercompany profits; intercompany mutual shareholdings; and disclosure methods and problems peculiar to consolidated reporting.

The major conclusions of the study may be summarized as follows:

1. The area of consolidation is based upon the existence of centralized control coupled with the integration of operations of two or more corporations. Stock ownership is the most convenient criterion of control but the accountant cannot rely on a specific stockholding percentage minimum in every case. The particular circumstances must be appraised. Lack of homogeneity of operations of two affiliates, as long as a combination of their activities in a single corporation would not be contrary to law or the interests of the public, is not a valid basis for excluding an affiliate from the area of consolidation.

2. The elimination of intercompany shareholdings usually results in an uneliminated difference. The accountant must make a maximum effort to ascertain the causes of such a difference and allocate it according to his findings. Under no circumstances should the recognition of goodwill of the consolidated group be a function of the relative sizes of the equities in the acquired affiliate.

3. The purchase of bonds issued by an affiliate, by another affiliate in the open market, constitutes financial retirement of those bonds to the consolidated entity. The gain or loss on bond retirement is to be attributed to the issuing affiliate for purposes of allocating consolidated income or loss to the various interests.

4. Asset valuation on the consolidated balance sheet

should reflect the cost (or other conventional basis) of those assets to the consolidation. Thus, all markup on intercompany transfers of assets must be eliminated. The appropriate valuation of assets and liabilities from the viewpoint of the consolidated group must precede the determination of consolidated capital. It is a violation of generally accepted accounting principles to assign a value to ownership equities and then to establish asset values which are necessary to maintain accounting-equation balance.

5. Mutual intercompany shareholdings represent treasury shareholdings and are to be treated accordingly.

6. The minority interest has none of the accounting characteristics of a liability and should not be treated in that way. It is a part of consolidated capital although it is a proportional interest in one unit of the consolidated group rather than a proportional interest in the entire group. The primary purpose of the minority interest on the consolidated balance sheet is the prevention of an overstatement of the controlling interest.

211 pages. \$2.75. Mic 56-2518

**MAJOR MANUFACTURING INDUSTRIES IN
WASHINGTON STATE: CHANGES IN THEIR
RELATIVE IMPORTANCE AND CAUSES OF CHANGE**

(Publication No. 17,128)

Fremont Ellsworth Kast, D.B.A.
University of Washington, 1956

The objective of this study is to determine the changes in the relative importance of Washington's major manufacturing industries between 1939 and 1953 and to investigate the significant factors causing these changes.

As a background for the investigation of each of the major industries, the historical development of the manufacturing economy is traced from 1900 to 1953. This introductory section includes the evaluation of the importance of Washington's manufacturing activities in the national manufacturing economy and the importance of the manufacturing sector within the Washington economy.

Investigation of the six major manufacturing industries shows that prior to 1939 Washington's industrial activities were based primarily upon the utilization of natural resources available within the state. For over 60 years, from the beginning of economic activity until 1939, the only major industries were lumber, pulp and paper, and food processing. During this period the state contributed only a small proportion of the national manufacturing activities.

Between 1939 and 1953 important changes occurred in the state's industrial structure. The lumber and food processing industries declined in relative importance and the pulp and paper industries maintained a relatively stable position. The important growth industries were transportation equipment, primary metals, and chemicals. These three industrial groups provided only a small segment of the state's economic activity in 1939 but by 1953 they had grown to positions of major importance.

The major reason for the decline in relative importance of the lumber and wood products group was the reduction in the most accessible and higher quality timber resources. This group declined even though there was more intensive

utilization and increased fabrication of the forest resources.

The food and kindred products group also declined in relative importance, contributing a smaller proportion of the state's manufacturing activity in 1953 than in 1939. This decline was normal for an economy which was gradually moving from the exploitation of raw material resources toward more diversified manufacturing activities.

The transportation equipment group had a substantial growth during this period. Shipbuilding and aircraft production expanded greatly during World War II and then declined drastically in the postwar period. Under the current program of emphasis upon the air force for defense, the aircraft industry has undergone another major expansion. However, shipbuilding has not expanded greatly and remains as one of the smaller segments of the state's economy.

The primary metal group also grew in relative importance with the aluminum industry showing the major expansion. An important factor attracting the aluminum industry to Washington was the availability and low cost of hydroelectric power together with a large expansion in the demand for aluminum products.

The chemical industries were the third group to assume a more important role in the economy. The major component of this group is the Hanford Atomic Products Operation. This project was started during World War II to produce fissionable materials for the atomic bomb. In the postwar period federal expenditures have transformed it from an emergency wartime operation to a permanent manufacturing facility.

The forces influencing the changes in the industrial structure between 1939 and 1953 appear to be continuing. There is a trend toward the continued diversification and integration of the state's manufacturing economy. A major factor stimulating this trend is the expansion of regional markets which provides the opportunity for growth of finished products manufacturing. The further growth of these industries will lead to a better balanced and more diversified industrial economy.

431 pages. \$5.50. Mic 56-2519

AN ANALYSIS OF GROUP DISABILITY INSURANCE

(Publication No. 17,261)

Jesse Fredrick Pickrell, Ph.D.
University of Pennsylvania, 1956

Supervisor: C. A. Kulp

This study is intended as a broad analysis of group disability insurance principles and practices. Many specialized studies and discussions of group disability problems and practices are available to the person interested in this field, but there is no single comprehensive source of information on the subject. This volume includes an analysis of the following group disability lines of insurance: (1) accident and sickness, (2) accidental death and dismemberment, (3) hospital expense, (4) surgical expense, (5) medical expense, (6) dread disease expense, and (7) major medical expense.

The study is based largely on a careful first-hand

observation of the group disability operations of seven of the eight largest group companies in the United States, which write over 60 per cent of all group disability insurance. The practices of a number of other companies have been examined in order to give a better-rounded picture of group disability operations.

A critical analysis of the following subjects is included: (1) the basic nature of group disability insurance, (2) master contract and certificate provisions, (3) the impact of the State non-occupational disability laws on group insurance, (4) Federal disability legislation, (5) the selling of group disability insurance, (6) installation and administration of plans, (7) calculation and regulation of premium rates, (8) underwriting, (9) dividend practices, (10) computation and regulation of reserves, and (11) the growth and potential of group disability insurance.

341 pages. \$4.40. Mic 56-2520

THE WESTERN HEMISPHERE TRADE CORPORATION ACT AND ITS IMPLEMENTATION—A FACET OF UNITED STATES FOREIGN COMMERCIAL POLICY

(Publication No. 17,270)

Samuel R. Sapienza, Ph.D.
University of Pennsylvania, 1956

Supervisor: Professor Roland L. Kramer

Statement of the problem

In 1942, in the midst of World War II, Congress passed the Western Hemisphere Company Act. The essence of this Act was the granting of a 14 percentage point reduction in tax to a United States company that abided by stringent requirements as to source of income.

Twelve years after the passage of the Act, a House Committee in the Report of the House Ways and Means Committee, H.R. 8300 (Internal Revenue Code of 1954), stated:¹

"Although your committee believes that the present Western Hemisphere trade corporation provisions produce some anomalous results, it has retained those provisions in order to avoid any disturbance at the present time to established channels of trade."

The results of this law are the foundation of this dissertation.

Procedure

To determine what may be called "United States commercial policy" in the Western Hemisphere, the tax law was studied from 1913 to date. Policies, evaluations, and descriptions of our tax law in this area were gleaned from statements of government officials, testimony at Congressional hearings, articles in journals, and books by authors in fields related to the topic.

In addition, the author conducted a survey - personal interviews and questionnaires - of companies actually operating as Western Hemisphere trade corporations. From personal interviews and questionnaires, 172 Western Hemisphere companies were contacted.

Results

While most of the companies surveyed might be called the "investment" type (i.e., actually have physical assets overseas), many of them are "export" type (i.e., business is done on a documentary basis). One whole chapter is devoted to the formation of a so-called "export" type corporation, discussing the range of problems encountered.

The sale of goods predominate as the basic source of income for Western Hemisphere companies. Most of these companies selling goods export from the United States. While in a minority, some companies do export to the United States under the Act.

The control over merchandise was usually effected through a branch type of operation. "Documentary" shippers were next in order, with consignment last.

Channels of distribution used by companies show a majority using company agents to pass title to the goods overseas. Foreign distributors ranked next, with many other agencies such as local plants and retail stores following.

Conclusions

The large, well-integrated company has found the Western Hemisphere Company Act as fetters to its operations. The imposition of rigid boundaries on a company that operates world-wide often gives rise to transactions that are, at best, cumbersome and, possibly, uneconomic.

The smaller exporter has refrained from claiming Western Hemisphere company status because of doubt as to the acceptance by the Internal Revenue Service (or by customers) of certain acts required to pass title to goods outside the United States. Despite this, some companies do pass title overseas on a documentary basis and claim what may be called an "uneasy" Western Hemisphere company status.

The competitive benefits supposedly behind enacting this law are impossible to single out. This factor seems to be overstated.

The maintenance of United States charters by many companies might well be styled the chief result of the Act.

The total income earned in the Western Hemisphere by direct investors was \$1.07 billions in 1950, and \$1.32 billions in 1951. It was estimated that \$.44 billion was earned by some 342 tax returns of Western Hemisphere companies in 1950, and \$.52 billion by 450 tax returns of Western Hemisphere companies in 1951.

The Act may be styled "regional taxation." In view of the commitments and interests of the United States, there is little need for such an approach to taxing foreign source income. The limited acceptance of the Act by companies that were capable of adopting this form of operation brings up doubt about the benefit of the law, at least on this restricted basis.

In sum, the law helped reawaken interest in the whole area of United States taxation of foreign source income.

292 pages. \$3.75. Mic 56-2521

1. Emphasis added.

WAGE SURVEYS AND WAGE POLICIES
OF OHIO MANUFACTURERS
(VOLUMES I AND II)

(Publication No. 17,404)

Robert Stansbury Stockton, Ph.D.
The Ohio State University, 1956

The objective of the study was information concerning the historical development and present use of survey data by manufacturing plants to implement a policy of wage and salary comparison.

A questionnaire was mailed to all Ohio manufacturing establishments employing more than 100 workers. Replies were received from 750, 40 per cent, of the 1,850 plants solicited. The response was tabulated by industry classification, size, union status, county location, and single- and multi-plant companies. Separate tabulations were made for factory and office jobs.

A comparison policy is a statement that establishes, as a principle of wage determination and equity, the necessity of correlating company rate structure with rates paid for comparable work in other business establishments. Nearly 90 per cent of the respondents have such a policy. Within multi-plant organizations the policy is applied to each establishment rather than to the company as a whole. Normally, this policy also includes a general specification of the expected relationship between plant and area wage rates. While many plants expect to pay rates above those typical of the area for similar work, most Ohio manufacturers expect to meet rather than to exceed area rates. Many values of comparison policy cannot be fully realized unless workers understand and accept it. A majority of the respondents, especially those exercising wage leadership, inform their employees of company policy. Explanation of policy during negotiations is the predominant communication method employed. Communication is less effective in non-union plants.

Company wage policy may also state that job evaluation will be employed to determine intra-plant wage differentials. Such a program has been adopted for factory jobs by 62 per cent of the respondents and for office jobs by 45 per cent. Since job evaluation represents an organizational approach to wage determination based on analysis of functional job content, establishment size was an important factor determining its use.

Of the establishments having comparison policies, 83 per cent use wage surveys and 69 per cent use salary surveys. Large plants, plants with unions, and those exercising wage leadership use surveys extensively. Personal knowledge of area rates is used instead of surveys in many small plants. A majority of the respondents consider survey data only one of several major factors in rate determination and ordinarily do not expect to introduce it into negotiations. About two-thirds began to use surveys after 1945; only 14 per cent used them prior to 1940.

Wage and salary surveys include data for a limited number of key jobs. Conclusions are drawn concerning the general level of the entire rate structure as compared with that found in other establishments on the basis of this sample. Salary comparisons are usually limited to the immediate geographical area. Rates are collected from a variety of business establishments employing clerical workers. Both area and industry comparisons may be used for factory jobs, although area rates are more important. Since

key jobs are used, data is collected only from plants employing similar labor skills in quantity.

Local employer associations are an important source of survey data in larger Ohio cities, especially for small plants. Information supplied by national associations is significant in certain industries. However, of the plants using survey data, over one-half conduct their own surveys. This practice is especially prevalent in large plants and multi-plant companies.

It is concluded that wage and salary surveys are an important part of the personnel programs of Ohio manufacturers. Because the type of survey data used, the source of data, and the emphasis placed upon it are reflections of company wage policy, these matters deserve executive attention and study. 560 pages. \$7.10. Mic 56-2522

STUDENT EMPLOYMENT OFFICES OF THE UNIVERSITIES OF THE WESTERN CONFERENCE

(Publication No. 17,495)

Leslie August Willig, Ph.D.
State University of Iowa, 1956

Chairman: Professor Karl E. Leib

Since World War II, there have been large increases in the birth rate in the United States. With an increase in the number of people reaching college age, it is likely that there will be an increased demand upon the services of the offices which place students into part-time jobs. Further, there will be an increased need for those people in the student employment field to consider the practices of the offices in light of their objectives. Perhaps certain practices which they are not now following would better enable them to more nearly meet their objectives.

The Problem

It appears that very little research has been recently conducted (and published) on the procedures followed in student employment offices. The purpose of this study was to conduct an exploratory survey of the nature of the objectives and the practices used in some of these offices. Further, it was the purpose of this study to consider the practices in light of the main objectives of the student employment offices.

Methods

Three questionnaires were constructed and sent to certain student personnel administrators of the universities of the Western Conference. The first, rather lengthy, questionnaire dealt with the actual practices of the student employment offices and was sent to the director of those offices. Six months later, the second and third questionnaires, which dealt with the objectives, were sent to the directors of the student personnel programs and to the directors of the student employment offices, respectively. For the purposes of this study, the three major objectives of the student employment office were considered to be (A) To enable as many students as possible to attend the institution, (B) To serve in the role of a parent surrogate to the students, and (C) To consider the activities in light of their effect upon public relations. All questionnaires were completed and returned.

Findings

1. There seems to be no great disagreement between the director of student personnel and the director of student employment (within the same university) regarding the major philosophies of their organization.

2. Much progress is apparently being made toward achieving the three major objectives of the student employment offices. However, more progress might be made by the following of certain procedures discussed in Chapter IV. Some of these procedures are (A) Contacting employers in search of additional jobs, (B) Evaluating the work of the placed applicants, and (C) Working with various civic organizations.

3. Budgetary inadequacies was the most frequently mentioned obstacle which prevents the achievement of the main objectives of the student employment offices. Some other obstacles mentioned were (A) Limited staff, (B) Conflicting course schedules, and (C) Lack of job vacancies. 114 pages. \$1.50. Mic 56-2523

AN INVESTIGATION OF EMPLOYEE ECONOMIC EDUCATION BY BUSINESSMEN, WITH AN EVALUATION OF THE TREATMENT OF CONTENT IN SELECTED MATERIALS

(Publication No. 17,153)

Allen Alderson Zoll, III, D.B.A.
University of Washington, 1956

The broad purpose of this study is to add to an understanding of employee economic education conducted by businessmen by: (1) distinguishing between two areas of economic instruction now being offered, (2) pointing out problems faced in such educational efforts, (3) suggesting criteria for evaluating the treatment of content in educational materials, (4) evaluating selected materials in each area, (5) analyzing the methods currently used to evaluate the impact, and (6) interpreting motives behind these educational efforts.

Within the broad scope of the definition of employee economic education, efforts of businessmen are largely being directed to two areas: (1) general economic education, in which substantial attention is paid to economic subjects such as institutions and theories, and (2) company economic education, in which information regarding the operation of a specific firm is transmitted.

General problems faced by a businessman wishing to engage in employee economic education include the selection of the medium of communication, orienting education to employees, the selection of content and designing the treatment of content.

Three questions, suggested as criteria for evaluating the treatment of content in materials, are concerned with whether or not the presentation is designed: (1) to help the employee think more effectively about complex reality, (2) to help the employee develop more penetrating, or critical, thought, and (3) to allow freedom for the employee to form his own conclusions.

A discussion is presented about two special problems which arise in the selection of subject matter for general economic education: (1) determining approach, depth and breadth of treatment, and (2) selecting the specific economic facts to be taught.

Three complete programs in popular use and samples of pamphlets and booklets being used for general economic education of employees are described and evaluated using the suggested criteria. The materials generally fail to meet the criteria.

The motives behind attempts at general economic education are explored beginning with an analysis of the point of view of some businessmen who urged such education for employees. They viewed business as being under attack by government and labor union forces--leading to socialism and collectivism. This trend was seen by them to result from a lack of popular understanding of business and economics.

In the few cases in which businessmen attempt to measure the impact of general economic education, the methods used fall into two broad categories: (1) measures of employee reaction to the experience, and (2) measures of employee change as a result of the experience.

Company economic education of employees reflects a change in attitude in management-employee relations over the last fifty years. Most of the educational activity of this type takes place through established channels rather than special programs.

The varied motives for company economic education include desires to: (1) integrate the goals of employees and employer, (2) explain the viewpoint and values of management, (3) defend some aspect of business, and (4) form attitudes toward larger social issues.

To present examples of company economic education, the programs of two companies are described and evaluated according to the suggested criteria. Both are found generally to satisfy the criteria.

For general economic education, conclusions are presented regarding the content of materials, the treatment of content, the appropriateness of business as an educational agency, the useful purposes served by such education and the reasons for the lack of any real evaluation. For company economic education, conclusions are presented regarding what can and cannot be expected from such education and the suitability of business as a source for this education.

Several implications raised by the study are discussed including the problem of raising the level of economic literacy among the general public and among businessmen, and the possibility of gaining greater acceptance of the institution of business. 380 pages. \$4.85. Mic 56-2524

ECONOMICS, FINANCE

RESPONSIBILITY OF CORPORATE FINANCIAL MANAGEMENT AS TO CAPITAL IMPAIRMENT UNDER PRICE LEVEL CHANGES

(Publication No. 18,110)

Joseph William Bachman, Ph.D.
University of Illinois, 1956

The modern business enterprise begins operations by receiving contributions of capital or capital funds which are used to acquire the assets necessary for productive

purposes. Corporate management assumes the responsibility of administration of the corporate resources of the enterprise. Financial management has a responsibility of maintaining the integrity of the business enterprise. The success or failure of the enterprise through the use of assets is measured by dollar profits which are influenced by inventory valuation and fixed asset depreciation. When price levels change more dollars must be reinvested to maintain the purchasing power of assets. Corporate management must maintain and preserve the capital of the enterprise. Does the responsibility of capital preservation extend only to the legal capital or does it include economic capital?

One of the most significant financial developments of the postwar period is the investment in plant and equipment financed with a small issue of new stocks. Internal funds provided approximately seventy per cent of total funds; common stock issues provided less than five per cent of the total. The over-all picture shows that the volume of funds provided by all forms of equity funds exceeded the funds obtained through creation of additional debt. The fundamental problem was the need for additional capital to replace existing plant and equipment and to finance a larger volume of business at a higher price level. To continue the efficiency of operation required the maintenance of the undiminished purchasing power of capital. This made advisable the retention of earnings in order to compensate for changes in the price level if the law of normal financial proportions was not to be violated. And the dollars of retained earnings represented dollar increases in net worth and as such served as a buffer for the debt. Thus a review of results of financial activities during the recent period of price fluctuation would lead to the conclusion that corporate financial management had a responsibility which extended beyond the maintenance of legal capital.

From the legal standpoint, capital would seem to be preserved if the capitalized value of the outstanding stock were held intact as a buffer to assure the payment of claims to the creditors. Therefore all dollar earnings of the postwar period might have been distributed without any guilt of legal negligence. From the economic standpoint, capital consists of the physical assets which are capable of a certain productive capacity. Capital is maintained only if the economic plant is maintained. If all earnings had been distributed as dividends, the firm would need new capital to maintain capacity--reflected in higher replacement costs for both inventory and fixed assets. Although not guilty of legal negligence, corporate financial management might be guilty of professional negligence for having failed to preserve the real capital of the enterprise. From the accounting standpoint, management has violated no accounting principles in its policy of retention of earnings. However, had corporate management distributed all net income as shown by the corporate records kept in accordance with accepted accounting practice, it appears that corporate management might have been guilty of contributing to the erosion of corporate capital.

The responsibility of corporate financial management transcends the limitations of law and accounting to preserve the economic capital and thus to serve both private and social ends. Judging by past standards, it would appear that corporate financial management has succeeded in preserving and maintaining the capital of the enterprise, both legal and economic, and thereby likewise contributed to the well-being of the economy.

225 pages. \$2.95. Mic 56-2525

FEDERAL RESERVE SUPPORT OF TREASURY REFUNDING OPERATIONS

(Publication No. 18,075)

Deane Chalmers Carson, Ph.D.
Clark University, 1956

Supervisor: James A. Maxwell

In recent years economists have given considerable attention to the implications for monetary management of a large, short-dated Federal debt. The period following World War II was one in which the exercise of monetary restraint was impaired by Treasury-inspired maintenance of Government security prices at artificially high levels. Following the Treasury-Federal Reserve accord in 1951, the System regained a large measure of independence. Essentially, this meant that the System's primary criterion of action became that of promoting economic stability rather than that of maintaining a particular level or pattern of interest rates. The System did not, however, cast off its long-standing responsibility for maintaining orderly conditions in the Government securities market.

During the two-year period which followed the accord, the Open Market Committee assisted the Treasury in its debt refunding operations by making purchases of securities during subscription periods. The major purpose of this study is to examine the impact of this support of refinancing upon the ability of the System to restrain inflationary credit expansion. The following question is examined in light of the empirical evidence of the period between July, 1951 and October, 1952: Does support of Treasury refunding (in the absence of a continuous and general defense of Government security prices) substantially vitiate System power to affect credit conditions? This question was answered in the affirmative by the Open Market Committee, following a study by three of its members. The recommendations of this sub-committee led to the adoption of "ground rules" in March, 1953 which confined Committee operations to the short-term sector of the market and proscribed support of Treasury refinancing.

Examination of the subcommittee's report reveals the fact that its recommendations were based more upon the belief that minimum intervention in the market would improve the depth, breadth, and resiliency of the market than upon empirical findings that refunding support impaired the effectiveness of monetary restraint. While the latter was assumed, no evidence was presented.

Taking the period between July, 1951 and October, 1952 (for which there is accurate support data and during which all conditional elements of the problem were present), the writer concludes that support did not substantially interfere with the imposition of stringency in bank reserves and credit. Excess reserves were kept at low levels, and free reserves were negative in the latter part of the period; rediscounting rose to the highest level in twenty years and interest rates generally increased. Official System statements throughout the period indicated satisfaction with the degree of restraint imposed. Support was given to nine refundings, and several involved large purchases. The Committee, however, sold other securities either during the subscription period or between refundings.

The principal disadvantage of support is that it interferes with the timing of purchases and sales. This must be weighed against the advantages of refunding assistance,

the most important of which is that it obviates the tendency of the Treasury to underprice its securities in order to avoid heavy attrition in a falling market. This result is desirable, since it avoids "bonuses" to owners of maturing securities.

The writer concludes that any commitment by the Committee to support or not support refundings is undesirable. Rather, each refunding situation should be evaluated separately and the decision made with respect to Committee action. If the coupon set is in line with the market, and if the Treasury's cash balance is not large enough to sustain heavy self-support, it would not seem unreasonable for the System to make purchases. A firm commitment to support all refundings, however, would tempt the Treasury to maintain unrealistic interest rates.

196 pages. \$2.55. Mic 56-2526

DEVELOPMENT AND EVALUATION OF METHODS OF MEASURING NET INCOME IN INDEPENDENT RETAIL DRUG STORES AT THE DEPARTMENT AND COMMODITY GROUP LEVELS

(Publication No. 17,220)

Robert George Cox, Ph.D.
University of Pennsylvania, 1956

Supervisor: Professor W. E. Warrington

During the years 1950 and 1951, a research project entitled "The Drug Store Operating Cost Study" was sponsored and financed by interested groups in the drug industry for the purpose of obtaining current financial and marketing data at department and commodity group levels relative to operations of independent retail drug stores. Data for twelve drug stores selected in seven different areas throughout the United States were gathered by area supervisors and processed by the research staff located at the University of Pennsylvania.

This thesis is designed to examine and evaluate the methodology employed in the study with particular reference to measurement of net income at the department and commodity group levels. Although the methodology analyzed was developed for use in the study of drug store operations, its use is not limited to that field. Many of the problems encountered during field phases of the study, in tabulation of data and in presentation of findings exist in other retail and wholesale industries. In addition to the evaluation of the methodology, discussion of limitations inherent in this type of analysis and recommendations for improvements in methods should prove helpful to those interested in similar research.

Measurement of revenue at department and commodity group levels is affected by the nature of operations in small organizations. Since it is important not to interfere with normal business activities, the use of conventional accounting methods of accumulating classified sales data is precluded. Statistical collection of revenues can be employed more effectively.

Although manual methods may be used, punch card procedures are particularly useful in the determination of sales, merchandise costs of sales and gross margins. Machine accounting methods also may be used to produce valuable by-product information.

Application of distribution costing to small retail organizations is complicated by many problems. Of great importance are the following:

1. Clear-cut distinctions between products and activities of different departments seldom exist.
2. Products of different departments are often intermingled.
3. Expenses incurred are often recorded on a cash basis and must be converted to an accrual basis.
4. Reasonable compensation for an owner-manager must be estimated in lieu of proprietor's withdrawals.
5. Personal and business expenses are frequently combined and must be separated.

Evaluation of the methodology, analysis of the problems encountered in its application and limitations inherent in cost analysis are presented under the following chapter headings:

- I. Introduction and Background of The Drug Store Operating Cost Study.
- II. Measurement of Sales, Costs of Merchandise Sold and Gross Margins.
- III. Classification and Determination of Operating Expenses.
- IV. Allocation of Natural Expenses to Functional Groupings.
- V. Distribution of Functional Expenses to Departments.
- VI. Assignment of Departmental Expenses to Commodity Groups.
- VII. Presentation and Interpretation of Operating Data.
- VIII. Summary of Methods, Recommendations and Conclusions.
- IX. Illustrative Tables and Instructions to Area Supervisors. 364 pages. \$4.65. Mic 56-2527

SOME PROBLEMS OF FEDERATION IN THE BRITISH CARIBBEAN

(Publication No. 18,084)

William Adolphus Osborne, Ph.D.
Clark University, 1956

Supervisor: James A. Maxwell

In recent years the Colonial Office in London, in consultation with the legislatures of the Caribbean colonies concerned, has given serious thought to the proposition of creating a federation of the scattered islands and the two mainland colonies of British Guiana and British Honduras.

At the Montego Bay Conference of 1947 the Secretary of State for the Colonies, as the presiding officer, indicated both the desire of the British Government for federation and, in broad outline, the scheme thought to be feasible. Federation was to be accompanied by progress toward representative government and a loosening of guidance from

the Colonial Office. While some of the delegates felt that progress toward greater self-government might well precede federation, all of the territories, except British Guiana and British Honduras, subscribed in principle to the proposal.

A Standing Closer Association Committee of the British West Indies, made up of representatives from the territories involved, was created at the Montego Bay Conference. The Committee's task was to draft a constitution and to make other necessary recommendations. These recommendations are now being submitted to the colonial legislatures, and there is a possibility that the federation may come into being by 1957.

The islands are overpopulated, having a density ranging from 179 per square mile on Dominica to more than 1200 on Barbados. Present trends indicate that there will be a natural increase of approximately 30 per cent in fourteen years. Efforts will have to be directed towards an early solution of this grave problem if it is to be prevented from nullifying economic gains intended to raise the extremely low living standards of the area. The most likely approaches to an alleviation of the situation would be emigration, birth control, and better education.

It is reasonable to say that the hope of economic progress stemming from federation might have been the prime motivation of the Montego Bay Conference delegates. With carefully planned programs of determined length this hope might be realized. The main emphasis, from sheer necessity, would have to be placed on agricultural improvements such as soil conservation, land holding reforms, land settlement schemes, and widespread agricultural education for the peasantry.

Development of the tourist trade seems a promising method of augmenting income from foreign sources. Efforts here should be spearheaded by a Government-appointed board made up for the most part of people who are directly connected with the industry. North America would seem to be in the future, as it has been in the recent years, the most fruitful source of foreign visitors. Air transportation has put the farthest reaches of the Caribbean no more than six hours away from Miami, Florida.

The prospects of industrialization are fair, judging from reports made by industrial missions sent from the United Kingdom and the International Bank for Reconstruction and Development. A ten-year program of industrial development which calls for an expenditure of approximately WI \$480 million has been suggested. This amount must be financed in the main by foreign capital. The federal government must take the lead in this industrialization plan through legislation designed to create a favorable atmosphere for foreign investors. Some of the territories have already been passing laws of this nature. Along with industrialization the federal government would do well to foster and extend facilities for technical education so that more and more skilled men can be drawn from the local labor pool.

On the one hand, the colonies can lose but little from a federal form of government, while on the other hand the gains therefrom might be large.

291 pages. \$3.75. Mic 56-2528

THE PANAMA CANAL: A PUBLIC VENTURE

(Publication No. 18,090)

Walter Henry Zukowski, Ph.D.
Clark University, 1956

Supervisor: James A. Maxwell

The purpose of this study is to fill in gaps in the story of the Panama Canal. While the existing literature provides a chronological history of the canal, examines its engineering aspects and administrative arrangement, and describes its place in the world of diplomacy and international relations, very little has been done in the area of analytical economic history, and no examination has been made of the canal in action, i.e., whether or not the aims and objectives underlying the construction of the canal have been achieved.

The Panama Canal was preceded by the Panama Railroad, completed in 1855. Why, after nearly four hundred years of talk about a canal, was a railroad constructed rather than a canal? The answer is found, in part, in the existing climate of opinion. Canals were then in disfavor because of the unhappy experience of the several states in underwriting many unprofitable canal ventures. The railroads of the day, on the other hand, were making profits. Then, too, railroads required a smaller outlay of capital and had lower costs of operation than did canals. Although the need for transcontinental transportation was great, the traffic that would utilize a canal seemed insufficient to justify so great an expenditure of capital.

Not until 1904, after many years of planning and a period of actual construction by French entrepreneurs, did the federal government of the United States undertake construction of a canal. A major reason why the French effort failed and the effort of the United States succeeded was that the former was private and the latter public. The project required more capital than could be supplied by private enterprise. Investors were unwilling to supply large sums for a project that had no guarantee of profitable operation. There was the further risk that unstable Latin-American governments might bring about expropriation of the properties. In the final analysis, the project was undertaken by the United States Government because the canal was really a problem of national defense and economic development, and not a question of how much the project would earn as a business proposition.

The last part of the study tries to answer three questions: (1) Did the Panama Canal enhance the growth of world trade, (2) did it increase the mobility of United States military forces, (3) was it profitable as a business enterprise?

A study of the traffic history of the canal indicates that the canal did enhance the growth of world trade. The percentage growth of canal traffic has far exceeded the growth of world trade as a whole. During periods of prosperity traffic through the canal grew at an accelerated pace. Beyond a doubt the canal increased the mobility of our military forces. This follows directly from a comparison of the reduction in distances.

Profitwise the canal enterprise has not fared very well. Today, with the canal operating at near capacity, the canal company is not earning an adequate return on total net investment. However, the Panama Canal is benefiting the United States, and other nations, as it cuts distances and

thereby reduces transportation costs, resulting in lower prices of many commodities. The fact that the canal has played an important role in the economic development of the North and South American continents must also be considered.

The canal's primary impact is on the economic integration of the Americas. Strengthening economic ties with western Europe is secondary. Its effect, combined with that of the Suez, tends toward an integration of the entire world economy. To this extent there is realization of the canal's ambitious motto: "The land divided the world united." 563 pages. \$7.15. Mic 56-2529

ECONOMICS, HISTORY

AN EXAMINATION OF WILLIAM FELLNER'S
OLIGOPOLY THEORY

(Publication No. 18,146)

Robert Spencer Hancock, Ph.D.
University of Illinois, 1956

A recent reconsideration of oligopoly theory is William Fellner's Competition Among the Few: Oligopoly and Similar Market Structures. In this book Fellner attempts to develop an oligopoly theory with which realistic market inquiries might be concerned. His theory emphasizes that among oligopolists there is a strong tendency toward quasi-agreement or spontaneous co-ordination. The phenomenon of quasi-agreement is dependent on conjectural interdependence and quasi-bargaining among oligopolists. Fellner's theory serves as the conceptual framework for this dissertation.

The examination of Fellner's oligopoly theory was accomplished by attempting to relate the central principles of his oligopoly theory to actual market counterparts. The actual market counterparts were presented in four case studies constructed by the writer from empirical data. The case studies reflect selected competitive behavior in the cigarette industry, the competitive behavior of the Atlantic and Pacific Tea Company, the bargaining of the United Auto Workers for the principle of the guaranteed annual wage and competition in gasoline retailing. These case studies represent four extremely diverse competitive situations.

After establishing the theoretical framework and the situations of market reality, the writer attempted to relate Fellner's theoretical principles to actual market behavior. Six questions were posed which were answered by detailed analyses of Fellner's principles and the writer's case studies. These questions were: (1) Is the form of competitive practice (oligopoly) as common as inferred, (2) Is Fellner's theory one which accurately depicts business behavior, (3) Are Fellner's theoretical postulates accurately mirrored by the reality of the business world, (4) Is the principle of joint maximization of profits a realistic observation, (5) Do the factors which qualify or limit maximization of net returns actually function as postulated in his theory, and (6) If any, what are the shortcomings of his theory? From the writer's answers to the above questions certain specific and general conclusions were drawn.

Generally, it was found that Fellner's theoretical elements were in conformance with real competitive situations in oligopolistic markets. The writer's analyses support to a high degree the phenomena of conjectural interdependence, quasi-bargaining and quasi-agreement. It was concluded that Fellner should be credited for his attempts to inject reality into the theory of oligopoly. He made an intensive effort to explain actual market phenomena when the number of competitors is few. Finally, the writer concluded that Fellner should be credited with one of the first complete attempts to emphasize the role of businessmen's decisions and their influence on market behavior.

285 pages. \$3.70. Mic 56-2530

LABOR LEGISLATION OF MICHIGAN, 1909

(Publication No. 18,598)

Carl Eugene Parry, Ph.D.
University of Michigan, 1909

Abstract not available.

303 pages. \$3.90. Mic 56-2531

AN ECONOMIC HISTORY OF THE MESABI DIVISION OF THE GREAT NORTHERN RAILWAY COMPANY TO 1915

(Publication No. 18,204)

Joseph Wilmer Thompson, Ph.D.
University of Illinois, 1956

The history and development of the Mesabi Division of the Great Northern Railway Company divides itself into two main, and relatively clear-cut, phases. Wheat was the primary factor in the first period of its growth. The second phase of its development revolved around iron ore from the Mesabi Range. The focal point of the Mesabi Division, and of its wheat and ore operations, is the lake port of Superior, Wisconsin.

Several major factors contributed to the development of the Mesabi Division's wheat lines and wheat handling facilities. First was the position of the railroad's early lines in the very fertile wheat lands of central Minnesota and the Red River Valley. The second major factor was the leadership and management which James J. Hill provided. His managerial policies, including the building of a firm foundation of branch lines to capitalize on the wheat lands, were instrumental in developing a strong independent road with a large wheat traffic. With a lesser man than Hill at the helm, the St. Paul, Minneapolis and Manitoba, the direct predecessor of the Great Northern, might have become only a part of some other larger system, as did most of the early Minnesota railroads. His energy and foresight, instead, led to the building of the Manitoba's own line to the head of the Lakes, and to the development of extensive wheat terminal facilities at Superior.

Although wheat played a vital role in the first phase of development of the Mesabi Division, it took a secondary position with the growth of the more spectacular ore traffic. From the acquisition of the first small ore carrying

road by the Great Northern in 1898, the business of transporting ore rose to tremendous proportions. Again, just as in the case of wheat, largely due to the strategic position of an acquired railroad, and to decisive moves by Hill, a profitable ore traffic was developed.

Although available data preclude an accurate comparison of the revenues from ore operations and wheat operations, a comparison on a tonnage basis may be used as a measure of their relative importance. Within a short time after the acquisition of its first ore carrying railroad, ore provided a much larger part of the Great Northern's freight tonnage than did wheat and other grains combined. In 1898 grain contributed close to 50 per cent of the Great Northern's total freight tonnage, whereas the ore tonnage was insignificant. But, by 1903, ore traffic accounted for 36 per cent of the total tonnage, and grain had dropped to only 16 per cent. By 1911 iron ore was furnishing over 50 per cent of the Great Northern's total traffic, whereas grain contributed approximately ten per cent. The importance of the ore lines may be seen by the fact that in 1911 the Great Northern Railway Company, with over 7,000 miles of railroad, was receiving about 50 per cent of its traffic tonnage from the approximately five per cent of its lines devoted to ore traffic.

While many other railroads fell easy prey to panics and depressions, the Manitoba and the Great Northern, firmly based on two major commodities, first wheat and then iron ore, not only withstood these economic slumps, but paid dividends in every year from 1882 through 1915. Economically, the Mesabi Division has played an important part in the welfare of the Great Northern, and in the welfare of the city of Superior as well, over the years.

391 pages. \$5.00. Mic 56-2532

ECONOMICS, THEORY

THE PLACE OF KEYNES IN THE HISTORY OF ECONOMIC THEORY

(Publication No. 17,446)

Leon Francis Lee, Ph.D.
Louisiana State University, 1956.

Supervisor: Professor Harlan L. McCracken

The general reference of this study is to the relationships between the economics of John Maynard Keynes and received economics. The term "received economics" refers to the economic theory promulgated before Keynes. The specific problem was to place properly the economics of Keynes in the history of economic theory with specific reference to his more important antecedents.

Within this frame of reference, the following aspects of Keynesian economics were examined: (a) his general demand analysis, (b) his theories of value, (c) his doctrine of effective demand, and (d) his monetary theory. The research took the form of examining the works of those economists who have been largely responsible for the formulation of economic theory from the period of Mercantilism to Keynes. Primarily, this involved the Classical School,

Austrian theory, and the thought systems of some of the so-called economic "heretics."

The results of the study strongly indicate that economists may confidently reject the hypothesis that the idea system of Keynes constituted a break from the past and created a new economics. The demand analysis employed by Keynes had its beginning with the Austrians. Insofar as he embraced a labor theory of value, Keynes accepted--at least in part--the value theory of the Classicists. His commanded value theory was derived directly from the Austrians, and his expectation theory of value was virtually identical with John R. Commons' volitional theory of value. The doctrine of effective demand has a long and interesting history. With reference to this doctrine, Boisguilbert, Lauderdale, Malthus, Sismondi, Aftalion, Hobson, and others were important predecessors of Keynes. Macroeconomics was by no means original with Keynes. All business cycle theories run in macroscopic terms. The consumption function has long been a major factor in underconsumption economics. And, of course, it was vir-

tually stated in Engel's Law of Consumption. Keynes' attack on saving and his enthusiasm for spending was a concept which has been present in the literature of economics for at least two centuries. Keynes was a monetary "heretic," but there were important antecedents to his monetary theory and to his distrust of financial capitalism. Finally, the General Theory is full of tendency concepts quite in keeping with classical economics.

The general conclusion is that Keynes took scattered ideas that had long been present in economic thought and formulated an economic theory that was an intellectual response to existing economic conditions. The General Theory of Employment, Interest, and Money marked an important milestone in the development of economic theory; it caused all economists to re-evaluate their fundamental theories. But it cannot properly be referred to as the "Keynesian Revolution." It was simply an important part in the evolution of economic theory.

261 pages. \$3.40. Mic 56-2533

EDUCATION

EDUCATION, GENERAL

THE HONORARY LEADERSHIP FRATERNITY IN AMERICAN SOCIETY: A SURVEY ANALYSIS OF FLORIDA BLUE KEY MEMBERS AND NONMEMBERS

(Publication No. 17,543)

Albert Walter Boldt, Ed.D.
The University of Florida, 1956

Purpose

The purpose of this study was to determine a relationship between membership and nonmembership in Florida Blue Key and achievements in an out of college.

Procedure

Four hundred twenty active members of Florida Blue Key who were graduated not later than June 7, 1948, were selected for the study. No honorary members were included. A non-Blue Key group, composed of individuals selected from the alumni population by stratified sampling, was carefully matched with the 420 Blue Key members with respect to age, degree received, size and type of secondary school, public or private secondary education, geographic location of home community, socio-economic status of family, type of college preparation, place of birth, and extra-curricular activity.

Questionnaires were sent to the 840 Blue Key and non-Blue Key members requesting information on college and post-college activities. A total of 531 questionnaires were returned, 302 Blue Key members and 229 non-Blue Key members.

Conclusions

1. The Blue Key member was a better student scho-

lastically than the non-Blue Key member. A greater percentage of them were graduated with honors than were the non-Blue Key members by a ratio of three to one.

2. The Blue Key member held more memberships in campus organizations than did the non-Blue Key member by a ratio of three to two.

3. Mothers of Blue Key men had completed more formal education than had mothers of the non-Blue Key men. The amount of formal education of the fathers of both groups was about equal.

4. Blue Key membership and membership in a social fraternity bore no relationship to grades. The Blue Key fraternity members did significantly better than the non-Blue Key fraternity members.

5. The Blue Key members, although not participating in as many campus activities, held significantly more offices than the non-Blue Key men at the ratio of two to one, indicating that office holding as an expression of leadership was a high criterion for election to Blue Key.

6. The mean age for graduation from college for both groups was 24.6 years. Three-fourths of the members of each group said college subjects aided them materially in preparing for their present occupation.

7. The Blue Key member averaged \$2,000 per year more mean income than the non-Blue Key member. In forty years of earning capacity this would put a net worth of \$80,000 on such membership.

8. A small proportion of the Blue Key members remained non-commissioned officers and more of them rose to high military rank than did the non-Blue Key members.

9. The men of both groups were married approximately three years after graduation at a mean age of 28 years. The average age of their wives at the time of marriage was 23.

10. The Blue Key man married a woman who completed more advanced education than did the non-Blue Key man's wife, but the amount of the wife's education bore no relationship to marital happiness in either group.

11. The lawyers in both groups were the primary holders of public office, with nonlawyers holding relatively few such offices.

12. Although there were minor differences between the two groups studied, no conclusive proof can be claimed for the superiority of one group over the other.

164 pages. \$2.15. Mic 56-2534

A STUDY OF TEACHER PARTICIPATION IN POLICY MAKING IN ST. LOUIS COUNTY

(Publication No. 17,174)

Mark Allen Boyer, Ed.D.
Washington University, 1956

Chairman: Dr. Adolph Unruh

This study was undertaken in an attempt to determine the extent of teacher participation in policy making and the attitudes of teachers, superintendents, and board members toward it. The need for the study was evident in the review of literature and research studies. A basis for teacher participation was found in the principles of democratic administration, statements of recognized educators and learned organizations, and the findings of educational research.

The normative-survey method was used; the instrument was the mailed questionnaire. Possible areas of existing policy were secured from regulations of boards of education and written statements of teachers. The eighty-two areas obtained were submitted to selected professors of educational administration. Of these, thirty areas, on which more than 60 per cent of the professors agreed, were used in the questionnaire. These were pupil conferences, homework for pupils, control of pupils, promotion of pupils, parent conferences, supervision of playgrounds or halls, reporting to parents, extracurricular activities, pupil placement, grading system, textbook adoption, letters to parents, freedom of teacher, faculty meetings, extra duties, recess periods, testing program, selection of educational supplies, professional growth, gifts for teachers, curriculum, salary schedule, public relations, sick leave, class size, maternity leave, promotion of teachers, teacher rating, building program, and budget.

The information requested on the questionnaire included: (1) what school policies existed, (2) whether existing policies affected teachers, (3) how policies were determined, and (4) how policies ought to be determined. Three levels of participation were presented: (1) cooperative, (2) suggestive, and (3) autocratic. An opportunity was afforded participants to express opinions concerning available channels of communication, the interest of superintendents in obtaining the advice of teachers, the responsibilities involved in policy making, and the qualification of teachers to participate.

The data were secured from teachers, superintendents, and board members in St. Louis County, Missouri. The returns from teachers and superintendents were consid-

ered to be a representative sample. Since few returns were received from board members, they were not held to be representative and the findings applied only to those members who replied. The responses were analyzed and the relationship between them was studied by the rank-order method of correlation. The teachers' responses were analyzed according to position, degree, size of district, and years of experience.

The conclusions are:

1. Teachers did not participate in developing existing policies in as many areas as recommended by experts.
2. Principals participated in policy development to a larger extent than other teachers.
3. Superintendents and board members believed teachers participated more than teachers themselves reported.
4. Teachers did not participate in the development of policies in the areas of budget and building program.
5. Teachers expressed confidence in their superintendent, believing he was interested in obtaining ideas and opinions of teachers.
6. Teachers, superintendents, and board members desired some form of teacher participation in all areas listed.
7. Teachers, regardless of position, degree, size of district, or years of experience, preferred participation by the cooperative method in all areas except budget and building program.
8. More teachers preferred cooperative participation in areas relating to everyday classroom problems than to administrative problems.
9. Teachers, superintendents, and board members did not desire the autocratic method of policy making.
10. Superintendents desired teacher participation by the method of suggestion in areas of budget, building program, class size, and public relations.
11. Teachers' desire for participation was greater than actual participation in all areas except budget and building program.
12. Teachers and superintendents were confident of the ability of teachers to participate.

247 pages. \$3.20. Mic 56-2535

AN ANALYSIS OF THE BUREAU OF YOUTH SERVICES IN THE CONNECTICUT STATE DEPARTMENT OF EDUCATION AND THE EXTENT TO WHICH ITS LEADERSHIP SERVICES ARE USED BY THE SECONDARY SCHOOLS OF CONNECTICUT

(Publication No. 18,319)

Francis Cyprien Champagne, Ph.D.
The University of Connecticut, 1956

The Problem

This thesis reports on a study made of the Bureau of Youth Services in the Connecticut State Department of Education. This Bureau offers a number of services and carries on a series of activities aimed primarily at the improvement of secondary education. In brief, the problem was one of finding the extent to which the services of the Bureau were known and used in the secondary schools of the State: and to ascertain how effective these services were considered to be by the principals of those schools.

Sources of Data

Data were collected over the two-year period, 1953 to 1955, chiefly from the following sources:

1. Historical records of the Connecticut State Department of Education and of the Bureau of Youth Services
2. Bureau records, policy statements, and publications
3. The professional staff of the Bureau through planned conferences and interviews
4. The principals of secondary schools of Connecticut through questionnaires.

The Bureau of Youth Services

The Bureau of Youth Services was established by the Connecticut State Board of Education on September 3, 1941. For some time prior to this date, officials in the State Department of Education were concerned with the lack of suitable vocational and educational opportunities for large numbers of Connecticut youth. Since it was established, the Bureau has undergone many changes in direction and personnel. The original problems that led to the establishment of the Bureau have been somewhat alleviated, but many problems of youth of concern to the Bureau still remain.

Findings on the Services

Some of the more important findings on the services of the Bureau may be summarized as follows:

1. The various areas of service for the most part were well known to the principals of the secondary schools.
2. The services of the Bureau were used in a majority of the secondary schools either occasionally or frequently in eight of the eleven areas of service.
3. The three areas of service used in the largest number of schools were industrial arts, business education, and driver and safety education.
4. The three areas of service used in the fewest schools were civil defense, counselor training, and regional high schools.

5. Areas of service that have vocational or practical aspects were used most frequently.

6. By and large, the effectiveness of the Bureau's work was rated very high, and in only three areas - communication arts, counselor training, and civil defense - were there indications that some needs of the schools were not being met by the Bureau.

Conclusions

On the basis of data gained from all the sources utilized in the present study, certain conclusions may be drawn, as follows:

1. Leadership services.-- There is evidence that principals of the secondary schools are aware of the many problems that face their schools and have come to expect certain leadership services from the Bureau to help solve these problems.

2. Evaluation of the work of the Bureau.-- The secondary school principals find much in the work of the Bureau that is satisfactory and commendable. The consultants are held in high esteem by the principals and there seems to be little or no fear that the Bureau is trying to dominate the secondary schools of the State.

3. Inadequacies in the work of the Bureau.-- The aspects of the work of the Bureau that are considered unsatisfactory are chiefly inadequacies caused by lack of adequate personnel in the Bureau.

4. Youth needs.-- It is clear that the needs of out-of-school youth in Connecticut are not being adequately met by the present services of the Bureau.

5. Orientation needed.-- It appears that there is a need for more adequate orientation of the secondary school people of the State concerning some aspects of the leadership services of the Bureau.

180 pages. \$2.35. Mic 56-2536

THE STATUS OF THE RETIRED WHITE TEACHERS OF LOUISIANA

(Publication No. 17,437)

Lena Young de Grummond, Ph.D.
Louisiana State University, 1956

Supervisor: Dr. M. S. Robertson

The purpose of this study was to determine the status of the retired white teachers of Louisiana. This was done through a study of their (1) age; (2) sex; (3) health; (4) service as teachers; (5) economic status; (6) religious, civic, and social activities; (7) continuing professional activities; (8) recreation and hobbies; and (9) the suggestions and comments made by retirants. These data were taken from answers to questionnaires sent to all white retirants from the Teachers' Retirement System of Louisiana who were on the mailing list of the system on January 1, 1955.

A total of 513 retirants was included in this study: 140 men, 359 women, and 14 who failed to indicate their sex. Their ages ranged from below 55 to over 90 years. The majority were in good health.

Service and training. The men taught a median of 35.66 years in Louisiana; the women, 33.16. The median years of college training was five for men; four for women.

Economic status. The service plans of the Teachers' Retirement System of Louisiana accounted for 82.1 per cent of the retirements; the disability plans, for twelve per cent. Of the men, eighty-seven and two-tenths per cent; of the women, 29.2 per cent were living with their spouses. Approximately three-fourths of the women and half of the men had no dependents.

The majority were apparently dependent on their retirement allowances, the median of which was \$2033.83 for men and \$1466.16 for women. Seventy-eight and eight-tenths per cent were not gainfully employed. Only 8.8 per cent received social security benefits. Homes were the only real estate owned by the majority.

Religious, civic, and social activities. More than 90 per cent reported being members of local churches and attending services regularly. Women apparently favored church, civic, and social organizations; men favored school, fraternal, and veteran organizations. Four hundred seventeen of the 513 retirants belonged to at least one organization. Additional activities reported were: visiting friends, shopping, attending picture shows, listening to radio, watching television, reading, and attending meetings.

Continuing professional activities. Active membership in professional organizations was continued by 40.9 per cent.

Recreation and hobbies. Reading and flower gardening were their favorite hobbies. Their three favorite magazines were: *The Reader's Digest*, *The Saturday Evening Post*, and *Ladies Home Journal*; their three favorite books: *A Man Called Peter*, *The Silver Chalice*, and *The Robe*. Interest in a club for older people was expressed by 81.9 per cent of the retirants.

Suggestions and comments made by retirants. Suggestions for preparing for retirement emphasized the necessity of developing many interests and varied hobbies early in life; having friends; saving regularly and investing wisely; owning a home; and developing a wholesome attitude toward retirement. The factors contributing most to satisfaction during retirement were: financial security, friends, a home in a familiar neighborhood, religion, reading, growing flowers and other hobbies, enjoyable activities, good health, and a feeling of usefulness.

The recommendations given in this study included: (1) adding a retired teacher to the Retirement Board; (2) issuing a handbook of policies, procedures, and regulations of the system to all teachers; (3) encouraging teachers to prepare for retirement mentally, spiritually, and physically; (4) setting a more generous minimum retirement allotment; (5) giving credit for out-of-state teaching; (6) allowing retirants to do substitute work; (7) suggesting that retired teacher groups explore the possibilities of employment opportunities for people over sixty, of cooperative living arrangements, of group insurance, etc.; and (8) encouraging retirants to assume their place in society as mature citizens who, while they have made a great contribution to their schools, communities, and society, are competent to make other equally important contributions. This study indicates that they are capable of doing this.

130 pages. \$1.75. Mic 56-2537

THE MULTIPLE COUNTY APPROACH TO SCHOOL DISTRICT REORGANIZATION IN IOWA

(Publication No. 17,466)

Henry C. DeKock, Ph.D.
State University of Iowa, 1956

Chairman: Associate Professor S. J. Knezevich

The principal purpose of this study was to illustrate the development of the multiple county approach to school district reorganization in Iowa. The state was divided into twenty-six multiple county areas. The area comprising Keokuk, Mahaska, and Washington Counties was selected for more intensive study because it showed greatest need for reorganization.

The conceptual pattern of the multiple county approach involves the following steps:

1. Determination of population concentrations surrounding the multiple county area. These should have sufficient pupils to permit reduction in the area to be merged with them without seriously impairing the adequacy of their educational programs.
2. Delineation of tentative boundary lines which lie within reasonable high school transportation distance from the population concentrations and the high school centers located within the boundary lines of the multiple county area.
3. Study of school districts within the core area and the tentative boundary lines with a view to combining districts into proposals for new units.
4. Determination of definite boundaries for proposed districts where this is justified by the obtained evidence.
5. Designation of open boundaries where evidence for exact location is lacking.

As a background for developing suggestions for implementing the reorganization plan, information was sought concerning factors which tend to help and factors which tend to retard progress in school district reorganization in Iowa. This study was also concerned with the development of an improved measure of progress in school district reorganization.

A county index of local school district adequacy was developed which included the following factors: (1) per cent of districts which meet the minimum criteria; (2) per cent of pupils and assessed valuation of property included in adequate districts, and (3) the degree to which all the districts achieved adequacy. The principal criteria for determining school district adequacy were comprehensiveness of the educational program, and a minimum resident enrollment of 650 pupils. The difference between the 1955 and 1950 indexes was used as the measure of progress for each of Iowa's ninety-nine counties. The range in index values from the lowest to the highest ranking county increased from 35.68 in 1950 to 43.29 in 1955. The index value for fourteen of Iowa's counties was lower in 1955 than in 1950.

Questionnaires were mailed to every county superintendent of schools, county board president, and county extension agent in Iowa. The factors viewed by most of the respondents as helping progress in school district reorganization were: (1) desire of rural people to obtain a wide range of opportunities for the social development of their children; (2) recognition that large school districts can attract and hold good teachers. The factors viewed by

most respondents as retarding reorganization were: (1) fear that the small community center will be weakened; (2) fear of increased taxes.

This study proposes that 280 school districts in Keokuk, Mahaska, and Washington Counties and the bordering townships in ten surrounding counties be combined into sixteen school districts.

A comparison of the 1954-55 current operation costs and the estimate of costs under the reorganized program reveals that a savings of 8.21 per cent could have been effected. The proposed plan would reduce the inequality of ability to support education in terms of assessed valuation per child from an existing ratio of 134 to 1 to a ratio of 2.75 to 1. 481 pages. \$6.15. Mic 56-2538

A STUDY OF MORAL, SPIRITUAL, AND RELIGIOUS VALUES IN THE PUBLIC SCHOOLS OF VIRGINIA

(Publication No. 17,631)

Luther Flynn, Ed.D.
University of Virginia, 1956

In this study the history of religious education in the schools of Virginia was traced from colonial times to the present. Then a study was made to determine present programs in the public schools of Virginia for the achievement of moral, spiritual, and religious values. To get this information, questionnaires were sent to all of the division superintendents in the state, and to 136 school principals in all parts of the state. Records were studied and many personal interviews were had.

Four particular types of approach to the matter of moral and spiritual values were found to exist in the public schools. They were, (1) activities such as devotionals and opening exercises, (2) a special program set up by the county school administration, (3) the program of "released time" weekday religious education, and (4) Bible study classes in high school. But Bible study for credit was found to exist in only eight high schools of the state in 1953-54.

A study of each of these programs was made in general, and then this was followed by an intensive study in three counties, each of which had a different type of approach to the problem of moral and spiritual values.

The literature in this field was examined to determine a set of concepts, or values, which leaders believe should be attained as a result of moral and religious teaching in the public schools. The present programs were then examined in the light of these values.

The concepts obtained were all grouped around the ten values listed in Moral and Spiritual Values in the Public Schools by the Educational Policies Commission. These values are as follows:

1. Human Personality
2. Moral Responsibility
3. Institutions as Servants of Men
4. Common Consent
5. Devotion to Truth
6. Respect for Excellence
7. Moral Equality
8. Brotherhood
9. The Pursuit of Happiness

10. Spiritual Enrichment

11. Special Religious Values, added to the list of ten.

A test composed of a set of essay type questions, or problems, designed to test results of training for moral and spiritual values according to the concepts set up, was given to the seventh grade pupils in three counties. Each county had a special type of program which was different from the program of the other two counties. An objective Biblical information test was also given to the same pupils.

The topics used in the test were so designed that answers or statements made on the topics by the pupils should reveal comprehension of, or attitude towards, most of the values under consideration.

A random sampling of the papers were checked for each county and the results tabulated separately. The county with the religious education program scored 28.41 per cent of all possible points; the county with devotionals only, scored 24.64 per cent; and the county with its own program scored 22.42 per cent. On the Biblical information test the county with devotionals only, scored 43.21 per cent; the county with religious education scored 41.11 per cent; and the county with its own program scored 39.54 per cent.

The total figures seem to indicate that the county with religious education in the public schools is achieving the moral and spiritual values used in this study to a somewhat greater degree than are the other two counties. The data from the county with no organized program indicate that much can be done toward the development of moral and spiritual values even without a carefully planned program.

Replies from the questionnaires indicate that much is being done in the public schools of Virginia for the development of moral and spiritual values. But the results of the tests indicate that much more needs to be done. Also a more intensive study needs to be made of what is being done, and how best to evaluate the results of these efforts for the achievement of moral, spiritual, and religious values in the public schools of Virginia.

236 pages. \$3.05. Mic 56-2539

IMPROVING READING INSTRUCTION IN THE INTERMEDIATE GRADES THROUGH PARTICIPATION IN A SPECIALLY PLANNED SUPERVISORY PROGRAM

(Publication No. 17,445)

Thomas Ray Landry, Ph.D.
Louisiana State University, 1956

Supervisor: Professor E. B. Robert

The study was concerned with the worth of supervision and the role of supervisory leadership. Specifically, its purpose was to determine the effects of a specially planned supervisory program upon teaching and learning of reading in grades four, five, and six. It was conducted in Avoyelles Parish, Louisiana, during the 1954-55 school session by a member of the State Department of Education in cooperation with local supervisory and administrative personnel. Thirty-four teachers and four hundred eight pupils participated.

Procedures used in the conduct of the study were as follows: (1) teachers were paired on the bases of grade or

grades taught, age, sex, training, experience, pupil-teacher ratio, and teaching skill; (2) pupils within the classrooms of paired teachers were paired on the bases of age, years in school, school marks in reading, achievement test score, and intelligence as measured by the California Mental Maturity Test; (3) the control groups of teachers participated in supervisory activities that were essentially the same as those of the previous school years; (4) the experimental groups of teachers participated in a special supervisory program which consisted of twelve system-wide meetings, follow-up faculty meetings, and individual experimentation and study; (5) California Reading Achievement Tests were administered to all fourth, fifth, and sixth grade pupils in September, 1954, January, 1955, and May, 1955 to compare achievement of the control and experimental groups; (6) teachers, principals, and supervisors provided supplementary evaluative data in the form of records and written reactions to questions, and (7) on the basis of the evidence gathered, conclusions were reached and recommendations were made.

The evaluative data indicated the following: (1) the experimental groups of pupils showed more reading achievement than comparable control groups in twenty-four of the twenty-seven comparisons made between the groups - the significance of superiority of the experimental groups in the area of total reading during the September, 1954 to May, 1955 interval being at the one per cent level in each grade and the actual superiority in terms of grade placement amounting to 4.5 months, 5.6 months, and 4.7 months respectively in grades four, five, and six; and (2) the experimental groups of teachers and their principals and supervisors gained much information, became acquainted with many new materials, did much professional reading, and improved their operational techniques during the session.

The conclusions were as follows: (1) the special-in-service supervisory program favorably affected teaching and learning of reading in the experimental groups in Avoyelles Parish during the 1954-1955 school session; (2) the supervisory techniques constituting the special in-service program - typical of Louisiana in the 1950's - improved instruction in the experimental groups; and (3) the exercise of vigorous leadership to the extent of initiating a special supervisory program in Avoyelles resulted in improved teaching and learning.

On the basis of these conclusions, the following recommendations were made:

Avoyelles Parish

1. That supervisory personnel plan to supplement the usual evolving supervisory activities with a special program each year

2. That in planning the special supervisory program emphasis be placed on one problem area through coordinating study on the parish, school, and classroom levels

3. That emphasis on reading be continued during 1955-1956, that all teachers be included, and that the pace be slower.

State of Louisiana

1. That systems without the services of adequate supervisory personnel give serious consideration to the advisability of adding the necessary persons

2. That school systems take the necessary steps to remove the obstacles to vigorous supervisory leadership

3. That more experimentation be conducted to determine the best use of available supervisory personnel at the state level

4. That supervisory personnel and others continue to seek evidence on the worth of supervision and the value of specific supervisory practices.

281 pages. \$3.65. Mic 56-2540

PRINCIPLES AND PRACTICES FOR THE DEVELOPMENT OF SPONSORED EDUCATIONAL MATERIALS AS EXEMPLIFIED BY THE EDUCATIONAL PROGRAM OF THE AUTOMOBILE MANUFACTURERS ASSOCIATION

(Publication No. 17,162)

Robert C. Lusk, Ed.D.
Wayne University, 1956

Free materials for school use can be a boon or a problem. When materials are properly conceived and executed, they may enrich classroom activities and give force to instruction. When they are not, they may be a waste of effort for the producer and the teacher.

This study makes available to potential producers of sponsored school materials some of the best thinking of educators about this topic as revealed in previous studies by educators and businesses, and reveals through a study of one major association's educational services program some of the practices of merit that may be considered by business-industry sponsors.

From these two sources, certain basic principles are identified and explained, so that those who would consider educational aids for schools may avoid some practices and follow others. Problems dealing with pre-production planning, actual production and testing, and evaluation of materials in use are discussed.

Selection of a medium best adapted to the particular materials to be presented is another vital step which is covered as an aid to the potential producer.

The genesis, development, and growth of a major association's school relations program, its connection with a commercial producer of school aids, program evaluation by its own staff and by an educational institution, and the decision to add a full-time staff person to deal with educational services is covered in detail.

The work of the director of educational services is reviewed, with particular emphasis given to new materials currently being distributed to schools, among them a film-strip, a bulletin board kit, and a map of the world showing the raw materials used in the manufacture of an automobile.

Future projects are outlined in some detail, with some of the reasons for their content and style of treatment given.

From earlier studies, the Association's history, and personal experience, certain criteria are specifically enumerated as a guide to those who would make their part of the business-industry story available for students and teachers.

135 pages. \$1.80. Mic 56-2541

**A SURVEY OF THE STATUS OF
PUPIL PERSONNEL SERVICES IN
SELECTED SCHOOLS IN NEW YORK STATE**

(Publication No. 18,305)

Spencer John Roemer, Ph.D.
Cornell University, 1956

It was the purpose of this study to make a survey of the status of pupil personnel services in certain selected public schools in New York State. More specifically, the study was concerned with (1) what is included in pupil personnel services; (2) who coordinates the program; (3) what his functions are; (4) what experience and training he has had; and (5) the problems faced in improving and expanding the present program in New York State.

The opinions of expert judges in the New York State Division of Pupil Personnel Services were used to select the thirty-one school systems with pupil personnel programs that were visited by the writer. A detailed, standardized, interview questionnaire concerning the program, the coordinator and the various pupil personnel services in each school system was prepared and used in the interviews of the pupil personnel staff.

Based on the survey of the thirty-one school systems described in the study, the following statements may be made:

- (1) The largest number of pupil personnel programs were found in areas of heavy population and rapid expansion of school facilities.
- (2) Smaller schools took advantage of pupil personnel services through participation in school services of either the Vocational Education and Extension Board or the Board of Cooperative Educational Services.
- (3) Coordinators lacked a consistent pattern in educational background, teaching and occupational experiences.
- (4) Pupil personnel services were not extended uniformly to all levels of education.
- (5) Rapid growth had caused problems in clarification of roles and functions, needless overlapping and duplication of efforts, burden of extra, unrelated functions.
- (6) Functions of the coordinators were largely administrative.
- (7) Major obstacles to personnel program were lack of staff and trained personnel, inadequate physical facilities, lack of full understanding by administrator and faculty.
- (8) Suggestions for training coordinators included teaching and administrative experiences, broad background in all aspects of pupil personnel work, especially human relations and experience in guidance and industrial training.
- (9) Coordinators pointed out:
 - (a) need for more in-service training, research, budget responsibility, and working with lay groups.

- (b) importance of administrator in initiating and exercising leadership in the organization of a personnel program.
 - (c) improvement in team approach through clarification and definition of roles among staff.
 - (d) value of continuous interpretation of personnel point of view to faculty, administration and community.
- (10) More than half of the school systems had a pupil accounting service as an integral aspect of the personnel program.
 - (11) Health services existed in all the school systems.
 - (12) Slight emphasis was given to emotional counseling.
 - (13) Psychological services were understaffed and overburdened.
 - (14) Home-Community-School services were the smallest in size of staff of any of the personnel services.

A comparison of the top functions of the five essential areas in the personnel program revealed opportunities for the team approach to reduce overlapping and duplication of efforts through:

- (a) Organization of a clinical team - medical, psychological staffs, and social workers - for complete examination of the child.
- (b) Establishment of a central, easily accessible file and uniform records.
- (c) Use of social worker as liaison agent between school, home and community.
- (d) Coordinator could represent over-all policy to administrator and faculty; provide in-service training for faculty and staff; promote research; develop harmonious relations among staff.
- (e) Cooperation of staff members in the preparation of complete case histories.
- (f) Preparation of clear-cut outlines of functions and responsibilities of staff.

Pupil personnel program should be adapted to the needs of the local situation in the school system and community. There is no one pattern. The program should not be imposed upon the system but should originate through the cooperation and support of the faculty and community.

174 pages. \$2.30. Mic 56-2542

ANALYSIS OF CERTAIN FACTORS IN
THE HIGH SCHOOL PREPARATION OF
IOWA HIGH SCHOOL GRADUATES
ENTERING SELECTED IOWA COLLEGES

(Publication No. 17,489)

Dwight Thomas Shafer, Ph.D.
State University of Iowa, 1956

Chairman: Associate Professor John E. McAdam

Purpose

The purpose of this study was to obtain data that might help to answer the broad question: What is the preparation of graduates of Iowa high schools who enter Iowa colleges? Answers were sought to the following questions.

1. What subjects are completed in high school and presented for college admission?
2. Is there any difference in the preparation of students who graduate from small or large high schools or who elect to enter a particular college?
3. How do entering freshmen rank in their respective high school graduating classes? What is the relationship between size of high school and rank in graduating class?
4. What is the relationship between size of high school attended and success in first year of college?
5. What is the relationship between mean high school grade point and the size of high school attended or the choice of college?
6. How do the successful and unsuccessful college freshmen compare on the factors of size of high school attended, pattern of subjects presented for admission, rank in graduating class, and scholarship in high school?

Procedure

The sources of information were the official records in the offices of the registrars of the State University of Iowa, Iowa State College, Iowa State Teachers College, Drake University, and Wartburg College. The sample was selected from those students who graduated from the public high schools in the Spring of 1952 and entered one of the colleges in the Fall of 1952.

The high schools represented were classified into five groups according to size of enrollment, Group I (0-99), Group II (100-199), Group III (200-499), Group IV (500-999), and Group V (1,000-up). Nine hundred twenty-two student transcripts were analyzed. High school subjects completed were classified under one of the following headings: English-Speech, Foreign Language, Mathematics, Science, Social Studies, Commercial Education, Practical Arts, and Miscellaneous.

The interpretation of data and comparisons that were made were based upon the per cent of students completing a subject. Standard error of the differences between the percentages were tested and accepted as significant at the one and two per cent level of confidence. Correlation coefficients were computed by Pearson Product Moment formula.

Conclusions

1. The large curricular offering in Iowa high schools is not reflected in the preparation of entering freshmen. Thirty-nine of the 371 subjects were presented by ten per cent or more of the students.
2. Differences exist in the basic subjects presented for college entrance between graduates of small and large high schools.
3. The findings in this study do not support the argument that colleges are being forced to change their entrance requirements because of increased curricular offerings of the secondary schools.
4. There is little difference in the pattern of subjects presented for college entrance between the superior student and the inferior student as evidenced by first year college scholarship. A larger number of subjects are presented by the inferior students and suggest that the inferior students tend to be uncertain of what subject to elect in high school.
5. The distribution of rank in high school graduating classes of entering freshmen is approximately the same for each of the colleges in the study.
6. The evidence suggests some relationship between pattern of subjects completed in high school and a particular college the student elected to enter.
7. The findings in the study indicate that scholarship in high school is one of the important pre-requisites for successful scholarship in college.
8. The size of high school attended is not a determining factor for the student who achieves scholastic success in the first year of college.

259 pages. \$3.35. Mic 56-2543

ACADEMIC REQUIREMENTS OF JOBS HELD BY
THE EDUCABLE MENTALLY RETARDED
IN THE STATE OF CONNECTICUT

(Publication No. 18,341)

Milton Abraham Young, Ph.D.
The University of Connecticut, 1956

Statement of the Problem

This study is an attempt to determine the academic requirements of jobs that educable mentally retarded individuals hold or have held in the State of Connecticut, based upon an analysis of 118 jobs. These academic requirements may include reading, mathematics, writing, spelling, oral language, and trade vocabulary.

Methods and Procedures

The first step in obtaining this information was to organize and test a job analysis sheet for academic requirements based upon the data needed for the study.

City and state job placement agencies in Connecticut were contacted and a list of jobs held by the educable mentally retarded and their employers was compiled.

After testing the job analysis sheet for academic requirements and organizing a suggested list of questions to be used with the instrument, the investigator analyzed 118 jobs by interviewing employers on the job.

The jobs analyzed were then classified into job areas by types of jobs and industries in which they were found. The job areas were: food preparation and service; laundry and cleaning; motor vehicle operation and service; hospital and institution work; building operation, maintenance, construction, and service; office, department, and small store jobs; and personal service and miscellaneous jobs.

The academic requirements for each job analyzed were then compared with the suggested grade placement of academic skills as listed in the Connecticut guide for elementary schools. A grade level was assigned to the most difficult requirement in each academic area. The data resulting from this analysis was then organized into three sections. The first section lists the specific academic skills for each job area according to degree of difficulty. The second section gives a suggested trade vocabulary for each job area in alphabetical order. The third section tabulates the results of the analysis of academic requirements classified by grade level for all 118 jobs studied and for each academic area, and oral language requirements by importance to job areas.

Conclusions and Implications for Curriculum Construction

An analysis of the data indicated that many of the jobs held by the educable mentally retarded required little or no academic ability. It was found that only 9.3 per cent of the jobs investigated required a sixth grade reading ability, while 67.8 per cent required reading of a second grade or less. Sixth grade competence in mathematics was required by 8.4 per cent of the jobs considered, whereas 69.4 per cent required second grade or less. Only 2.5 per cent of the jobs analyzed required sixth grade proficiency in writing and spelling, while 84.7 per cent required no ability in this area.

Curriculum workers should be aware of the demands that industry and society will make upon the educable mentally retarded socially, academically, vocationally, and physically, so that they may provide more adequately for the integration of these requirements. This study contributes information as to the academic requirements of jobs held by this group and suggests several concepts that should be considered by curriculum workers in the building of a curriculum for the educable mentally retarded.

The limited academic requirements of jobs held by this group is paradoxically fortunate for them, for we can now consider reducing the number of skills required in the ordinary curriculum and eliminating those skills which are too difficult and complex for the mentally retarded to learn. In their place we may build a special curriculum and include more of the specific academic and trade vocabulary requirements indicated by this and future studies and take a longer time to teach them.

123 pages. \$1.65. Mic 56-2544

EDUCATION ADMINISTRATION

A STUDY OF PROCEDURES USED IN THE SELECTION AND RETENTION OF SUPERINTENDENTS IN FIFTY SELECTED SMALL SCHOOLS

(Publication No. 17,584)

Milo Kasel Blecha, Ed.D.
The University of Nebraska
Teachers College, 1956

Adviser: Dean Frank E. Henzlik

The Purpose and Procedure of the Study

The purpose of this study was to determine the existing practices regarding selection and tenure of the superintendents in the selected small public schools, and to formulate a workable plan for their selection and retention.

To accomplish these objectives, the following procedures were used. Questionnaires were sent to the superintendents in fifty selected small public schools, and to twenty deans of education in major universities and colleges. The data received from these questionnaires were carefully examined to determine (a) the existing practices and (b) the recommended practices in the selection and retention of small public school superintendents.

To determine the significance of the questionnaire responses, a null hypothesis was postulated as a frame of reference and then tested for its statistical significance by using Leslie's chi square formula in multiple cells.

Results of the Study

The study revealed that the boards of education in the fifty selected public schools generally do not use a systematic plan in the selection and retention of a superintendent of schools. Superintendents in only two of the fifty schools indicated that their boards of education utilized a workable plan. Therefore, on the basis of, and as a result of this study the following sixteen criteria were formulated as a workable procedure. The criteria were developed on the basis of: (1) the extent to which they were verified by the jury, (2) the extent to which they were verified by the superintendents, (3) the extent of agreement among authorities in the field, and (4) the extent of statistical significance of the responses by the superintendents and the deans of education.

Criterion 1. The board of education should establish before hand, systematic procedures by which specific responsibilities are assigned to individual board members concerning selection procedures.

Criterion 2. The qualifications and characteristics felt to be desirable in a superintendent should be decided in terms of the needs of the community.

Criterion 3. The qualifications of the superintendent should be determined in terms of personal experience, professional training, and other experience considered necessary by the boards of education.

Criterion 4. The salary should be set at a definite amount contingent upon the desired qualifications before applications are received.

Criterion 5. Desirable candidates should be actively sought by the board.

Criterion 6. The qualifications desired in the superintendent and their importance to the community and school

should be formulated and made available for all prospective candidates.

Criterion 7. The board of education should designate one person to handle contacts and applications with prospective candidates.

Criterion 8. The credentials of the candidates should be studied and a select group of candidates with the best qualifications should be established by the board as a whole.

Criterion 9. Provision should be made for a personal interview with the best qualified candidates.

Criterion 10. The board should obtain accurate and reliable information concerning each candidate.

Criterion 11. The superintendent should be chosen by unanimous agreement of the board.

Criterion 12. The board of education should introduce and present the new superintendent in a favorable announcement to the community.

Criterion 13. The delegated duties and the responsibilities given to the superintendent by the board of education should be based upon mutual understanding and be clearly defined.

Criterion 14. The board should formulate a clear statement of written policies which clearly define the executive position of the superintendent.

Criterion 15. The board should have provision by which it evaluates the work of the superintendent.

Criterion 16. The board should provide and assure the successful superintendent tenure in the office for a prolonged period of time. 196 pages. \$2.55. Mic 56-2545

A COMPARISON OF SUBJECTIVE PREDICTIONS WITH OBJECTIVE PREDICTIONS OF COLLEGE ACHIEVEMENT

(Publication No. 17,630)

Marshall Moore Brice, Ed.D.
University of Virginia, 1956

The purpose of this study was to weigh several objective indices of academic success in college and to ascertain the degree to which they compared with predictions offered by teachers in secondary school. The objective factors included intelligence test results and twelfth grade averages. The subjective predictions, made by teachers, were reduced to statistical equivalents based upon a predetermined scale.

The study involved the investigation of high school and college records of graduates of the Staunton Military Academy in the classes of 1951, 1952, and 1953. It included only those students who took the college preparatory course at Staunton and who subsequently attended college for at least one semester. Records of 244 students, who attended 101 different colleges, constituted the source of the statistics.

The initial step in the investigation entailed the collection of college reports rendered on these 244 students and the computation of grade point averages, which became the criterion with which the predictive factors were compared. These grade point averages were only for the freshman year, or for so much of the freshman year as was officially credited by the college. There were six predictive indices: Otis intelligence quotients; Q-scores, L-scores, and total scores of the American Council on Education Psychological

Examinations; twelfth grade averages; and averages of teachers' predictions, called predictive rating averages. In the computation of predictive rating averages, each prediction made by a teacher was first converted to a numerical equivalent on a scale ranging from 0 to 100.

Correlations among these variables were calculated to determine the factors which most accurately predicted college success and to gauge the reliability of each predictive factor as compared with other predictors. Intercorrelations among the seven variables were also computed.

Only two of the predictive factors bore significant relationship to the criterion: the predictive rating averages -- that is, the averages of subjective predictions made by teachers -- correlated .479 with the grade point averages in college; the twelfth grade averages correlated .412 with college averages. The other predictive factors bore so negligible a relationship to college academic success as to merit no further consideration in this study.

Tables were then drawn up indicating the specific relationship between achievement in college on the one hand and twelfth grade averages and predictive rating averages on the other. These tables indicated that predictions of success had been more accurate than had predictions of failure in auguring particular grade point averages.

The results of the study would appear to warrant the following conclusions:

1. A secondary school which sends graduates to many different colleges should base predictions principally upon subjective estimates made by teachers and upon academic averages.

2. It is possible to reduce subjective predictions to numerical equivalents which are of somewhat greater reliability in prediction of college success than are twelfth grade averages and which, although influenced by secondary school marks, result from other factors as well.

3. Subjective predictions and twelfth grade averages are of value in guiding the student to the college and the course which promise greatest success. Of the two predictors, subjective predictions are of the greater reliability.

It would seem, from the results of this study, that much emphasis should be placed upon predictions made by secondary school teachers as to the potential success of students who are planning to enter college.

169 pages. \$2.25. Mic 56-2546

THE DEVELOPMENT OF THE NEBRASKA COMMON SCHOOL LANDS AND FUNDS

(Publication No. 17,586)

Freeman Bernard Decker, Ed.D.
The University of Nebraska
Teachers College, 1956

Adviser: Leslie L. Chisholm

The Purpose of the Study

The purpose of this study was to trace the development of the common school lands and the permanent and temporary school funds of the State of Nebraska and, on the basis of the data, to formulate conclusions and recommendations relative to the future management of these lands

and funds. It was thought that the study would prove to be of considerable value since nowhere was there to be found a similar study of this extent and purpose.

Methods Used

A detailed county by county study and record was made of every parcel of school land to see when it was first sold, when it was first deeded, the amount for which it was sold, and the appraised value of the remaining unsold land.

Five selected counties, in which all the school land had been sold, were used as a basis in making a comparison between the sale price of that land and the present estimated value of that land. This was done in an attempt to focus attention upon the mistake that was made in selling any of the school lands.

Another feature was to compile, over a fifty-four year period, the comparative return from the rentals of unsold lands and the return from the investment of the money in the permanent school fund. These amounts were reduced to percentages in another attempt to answer the question as to whether it was unwise to have sold any of the lands.

A study of the important supreme court cases dealing with the school lands was made in order to emphasize the importance of watchfulness in preventing this trust from being violated.

Results

The study revealed the following information:

1. Nebraska acquired 2,797,520.67 acres of common school land.
2. Nebraska has sold 1,086,432 acres of this land.
3. Nebraska now has 1,569,982.40 acres of common school land under lease.
4. The appraised value of the leased land now is \$35,544,015.00.
5. The permanent school fund now amounts to \$13,600,281.88.
6. The average return from the rental of school lands during the past is 5,633 percent.
7. The average return from the investments of the permanent school fund during the past is 3.677 percent.

Conclusions and Recommendations

1. None of the remaining school lands should ever be sold.
2. The state at an early date should study the question of whether the school lands should be (1) rented on the present basis, (2) a crop-share basis, or (3) if the federal government adopts the land bank program, a considerable amount of the land put in the land bank.
3. The staff administering the school lands and funds is inadequate and should be supplemented.
4. The board's duties should be confined to the administration of the school lands and funds and divorced entirely from present functions not related to those lands and funds.
5. The Board of Educational Lands and Funds should function under the direction of the State Board of Education or be appointed by that Board.

835 pages. \$10.54. Mic 56-2547

RELATIONSHIPS OF SELECTED CHARACTERISTICS OF ORGANIZATION TO PRACTICES IN SCHOOL SYSTEMS: AN EXPLORATORY MEASURE OF THE EXTENT OF DIFFUSION OF ADMINISTRATIVE PROCEDURES AND STAFFING PRACTICES AND THEIR RELATIONSHIPS TO SELECTED CHARACTERISTICS OF SCHOOL SYSTEMS

(Publication No. 18,144)

Harold Dale Hall, Ed.D.
University of Illinois, 1956

Some of the pressing questions today about the public schools call for reexamination of various facets of the organization and process of management. Educational leaders are constantly evaluating their school systems in an effort to determine the types of improvements in ends of education--namely instruction and learning--that may be accomplished by modifications in the means to ends--namely organization and processes. This type of evaluation falls short for lack of more definitive measures of the educational ends or accomplishments to which various facets of means are assumed to be related.

This study is one of a series of projects directed by W. P. McLure which are designed to measure various aspects of organization. This study is conducted under circumstances in which a criterion measure of educational programs in a sample of 27 school systems in Illinois is available to test the probable association of particular means with ends. The criterion measure consists of scores on each school system which were obtained in a previous study by independent observer rating on a standardized list of 112 critical items of educational practice (the McLure revision of the Mort-Cornell Guide). Four variables of organization and administrative processes are defined in this study:

1. The degree of diffusion of administrative procedures, or the extent to which certain tasks involve staff members in execution. This variable was measured by a questionnaire instrument which was developed in this study.
2. The adequacy of staff for the administrative function, as measured by the proportion of staff personnel in administration and supervision to regular teachers.
3. The extent of specialization in the instructional process, as measured by the proportion of staff personnel in specialized instructional areas to regular teachers.
4. The relative size of the auxiliary functions associated with instruction, as measured by the proportion of non-professional staff to regular teachers.

Measures are obtained on these four above mentioned variables in the form of quantifiable scores on each of the 27 school systems in the sample. Statistical tests of correlation and the "t" are utilized to relate scores of these variables to scores on the criterion measure of the educational program.

Two variables which are assumed to intervene in different combinations of the above named variables are as follows:

1. The size of the school in terms of number of weighted pupil enrollment.

2. The level of expenditure in terms of dollars per weighted pupil enrollment.

Fifth order partial correlation is regarded as the most critical test of relationship between pairs of variables.

The only relationships found in this study to be significant at the .05 level when this most critical test is applied are:

1. The extent of diffusion of administrative procedures to the quality of the educational program as measured by the instruments used in this study.
2. The level of expenditure per weighted pupil enrolled to the quality of the educational program as measured in this study.

The two factors found most highly related are the quality of the educational program and the diffusion of administrative procedures. The relationship between these variables suggests that there are certain characteristics of administrative operation which are found far more frequently in systems with enriched programs than are found in systems with limited programs.

It should be pointed out that there are different ways of regarding the quality of the educational program. Other criterion measures, which, like the one used in this study, give strong presumptive evidence of quality might yield more positive results when related to these variables.

This study is of exploratory character, particularly with reference to the measures of staffing practices. The method of obtaining indexes represents a limitation which further studies might be able to overcome. It appears that the three staff indexes of specialized functions, administrative-supervisory, educational specialist, and non-professional staff need further refinement and testing before intrinsic relationships with other characteristics of school systems can be established or disproven conclusively.

134 pages. \$1.80. Mic 56-2548

THE AMORTIZATION OF COMMITMENTS FOR CAPITAL OUTLAY IN CONNECTICUT SCHOOL DISTRICTS

(Publication No. 18,327)

John Anthony Langford, Ph.D.
The University of Connecticut, 1956

Statement of the Problem:

The purpose of this study was to discover how Connecticut has been amortizing capital commitments for schools. The study sought answers to the following questions:

1. What is the historical background of the school building program in Connecticut?
2. What procedures are followed now in amortizing school building debt?
3. What legal and financial limitations affect the program of amortization?
4. What is the nature and significance of State and Federal aid?
5. What are important criteria for a desirable program of State Aid for Capital Outlay?
6. To what extent are these criteria being met by the programs operating in the other states?

7. To what extent are these criteria being met in the Connecticut program?

8. What improvements are indicated in Connecticut practice?

Procedures:

The study includes historical review of financing school buildings in Connecticut; facts concerning current practices secured through questionnaires sent to town and city finance officers; location of and application of important criteria for desirable programs of amortization and state aid for building programs; and a detailed report concerning practices in 26 states.

Summary and Conclusions:

1. Connecticut has been building schools for over 300 years. Their financing was conducted on a pay-as-you-go basis, out of local funds, from Colonial days up to about 1880 when it became necessary to extend payment for more and larger schools over a longer period of financing. Bonding for school building became increasingly popular for towns and as school construction needs mounted in the 1900's, indebtedness grew to a total of some \$100,000,000 by 1952.

2. In the amortization of school building debt the following procedures are most common.

- a. Bonds are sold by local, state, or out of state agents about in equal number.
- b. More bonds are sold to out of state dealers.
- c. There is a tendency to favor the closed bid.
- d. The public is apparently well informed of sales.
- e. Bonds are certified more often by local agents.
- f. The Bond Buyer is the most popular medium of advertising.
- g. The most common term is twenty years.
- h. Interest rates were lower in 1952, rose in 1953 and have been commonly above 2.00 since then.
- i. Principal payments are made annually and interest, semi-annually.
- j. Most towns take advantage of a temporary investment of bond proceeds.
- k. Most towns have debt for school buildings.
- l. While there is no local policy in setting a bonding limitation, most districts are just below or slightly above 5% of the bonding limitation.
- m. It appears to be difficult to ascertain exactly what percent of any tax rise is positively attributed to the building of schools specifically.
- n. The Law which requires the sale of bonds in two years is apparently not affecting usual procedures and was approved by the majority of the respondents.
- o. Most towns were taking advantage of State Aid for Capital Outlay but only a limited few could qualify for Federal aid.

3. Data concerning state aid programs for capital outlay outside of Connecticut indicated that very few appeared to meet the criteria recommended for a superior program.

Several have been established to provide only temporary emergency aid or to offer loan assistance. Others are lacking in basic factors of equalization or fail to provide adequate help. State plans which include building construction aid in their regular Foundation Programs appear to meet most of the criteria.

4. The Connecticut program of school building aid has been instrumental in encouraging the construction of many school buildings and it meets some of the criteria but data reveal weakness with respect to the following:

- a. Including the factor of ability to pay.
- b. Offering incentive for larger administrative units.
- c. Adequacy of supervision by State authorities.
- d. The amount of the grant in relation to present school building costs.

216 pages. \$2.80. Mic 56-2549

A STUDY OF ADMINISTRATIVE, COUNSELING, AND SOCIAL PRACTICES AFFECTING FOREIGN STUDENTS AT AN URBAN UNIVERSITY

(Publication No. 17,161)

Virgil Robert Loughheed, Ed.D.
Wayne University, 1956

The purpose of the study is to ascertain current problems of foreign students at Wayne University as identified by the students themselves and to make certain recommendations about administrative and counseling practices.

Through a questionnaire of thirty-six broad items some 161 foreign students expressed themselves on topics dealing with their experiences and problems. The questionnaire was formulated so that the foreign student responded by rating most of his attitudes or opinions on a Likert-type scale from favorable to unfavorable or satisfied to dissatisfied. In addition to the rating on a Likert scale basis, the respondent was permitted to check the reasons for his attitude on a predetermined check list. Moreover, the questionnaire included open-ended questions to which qualitative answers were given by the respondent. Chi-square was used to check the hypotheses.

Following an overview of related literature and a resume of the design used in the study, Wayne University's history in foreign relations is told. Special consideration is given the unique problems of foreign students and their need for special advising.

Government actions affecting foreign students are discussed in detail, with specific attention to federal acts, the Immigration and Naturalization Service regulations, and required reports.

University procedures in admittance and counseling are reviewed, with major emphasis given to the role of the foreign student adviser. The attitudes of the respondents on these practices are tabulated and studied, with pertinent conclusions appended.

The results of the questionnaire concerning the on-campus problems of foreign students regarding housing, finances, health, academic success, and extracurricular activities are dealt with both descriptively and through evaluation of the problems as they affect the foreign student.

Off-campus experiences of foreign students, including general community contacts, home visits, and dating Americans are described from the data, and their importance as rated by the respondents is presented.

The study makes recommendations about the work of the Foreign Student Adviser, the selection and admittance of the students, orientation of the chosen students through the Foreign Student Office, and the need for improved channels of communication leading to greater use of the Office by the students.

In addition, broad suggestions are submitted concerning time allocation of the Adviser, foreign student-faculty relationships, specific language instruction planning for these students, broad introduction to American socio-economic and cultural patterns prior to University admittance, and appropriate housing plans.

The study further suggests that health insurance be mandatory, that intensive consideration be given the special financial difficulties of the foreign student, and that both community and campus activities for these students be fostered. A final concern is with the careful placement of students from abroad in American homes.

309 pages. \$4.00. Mic 56-2550

DEVELOPMENT OF TEACHERS' WORKSHOPS IN TWENTY NEBRASKA SCHOOLS

(Publication No. 17,588)

Glenn Arthur Lundstrom, Ed.D.
The University of Nebraska
Teachers College, 1956

Adviser: Dr. Merle A. Stoneman

This study was undertaken for the purpose of determining practices which were being used in the conductance of pre-school teachers' workshops in Nebraska public schools and to ascertain their function as an instrument of the total school program.

The procedures of the study were based on eight steps (a) evaluative criteria of workshop activities were obtained from the literature, (b) a comprehensive picture of teacher workshop activities was obtained from twenty Nebraska schools as reported by their superintendents, (c) a presentation of data from eighty teachers in the twenty selected Nebraska schools, (d) procedures by which superintendents approached the problem of teachers' workshops in their schools were described, (e) conclusions of teacher evaluations of workshop activities in their school was presented, and (f) presentation of other activities that were part of teachers' workshops.

Teachers' workshops in the twenty Nebraska schools that were studied have shown rather definite patterns. The primary purpose of this type of in-service training has been to improve instruction. The improvement of instruction for faculty members in these schools has been achieved in a number of ways, (1) assist all teachers on the staff to do better work as teachers, (2) assist new teachers to adjust to the profession, and (3) assist teachers who have returned to the profession. Other important aspects of the teachers' workshop included, (1) orientation and induction of teachers, (2) development of readiness for the new school year, (3) encouragement of professional

growth of teachers, (4) improvement of school attitude and esprit de corps, (5) motivation of instruction, and (6) focusing attention on new ideas.

More definite conclusions from this study are included in the statements which follow.

1. Teachers' workshops in the twenty schools of Nebraska that were studied held pre-opening sessions the week prior to the opening of school.

2. Compensation for attendance at the teachers' workshop was included as part of the required teaching contract in the majority of the Nebraska schools studied. Several schools stated that the workshop days were part of the 180 days included in the yearly teaching contract.

3. The teachers' evaluations of the workshop practices of Nebraska schools indicated teachers generally approved of the results of the workshops in the schools which they represented.

4. Teachers' evaluations of the workshops in Nebraska schools indicated that teachers wished to have more of a part in making the plans for the workshops in their schools.

5. The majority of the schools included in this study had no written school board policies which legislated the activities of the teachers' workshop.

6. Teachers' evaluations of the workshops in Nebraska schools indicated that teachers preferred discussion groups concerned with school problems as an important technique in the workshop program.

7. Teachers' workshops have been important as a means of providing in-service instruction for the twenty Nebraska schools that were part of this study.

8. Additional pay for attendance at the teachers' workshops was reported by only two of the twenty Nebraska schools studied. In these schools the teachers were not required to attend.

9. A majority of the eighty teachers who reported indicated the pre-opening workshops directly influenced their teaching procedures.

10. Teachers' workshops in the twenty schools in Nebraska that were included in this study indicated the workshops gave intensive consideration to practical problems that were of concern to them and their schools.

11. Business-Education Day was an important part of the teachers' workshops in many Nebraska schools that were part of this study. B-E activity helped to bridge school-community relations.

12. One of the deficiencies of the teachers' workshop in the Nebraska schools studied was their failure to provide a follow through plan of study during the school year that followed the teachers' workshop.

119 pages. \$1.50. Mic 56-2551

A FOLLOW-UP STUDY OF MALE LIBERAL ARTS COLLEGE GRADUATES OF WAYNE UNIVERSITY

(Publication No. 17,163)

James Donald Marsh, Ed.D.
Wayne University, 1956

This follow-up study of Wayne University male Liberal Arts graduates, embracing four graduate periods judged to be characteristic of the institution's development from 1925 to 1950, was undertaken in the hope of realizing an

increased understanding of the graduate product of these years by virtue of factual knowledge of post-graduate life outcome.

Greater objectivity of institutional direction was considered a possible end result of the specific examination of such factual data as: the planned and realized vocational objectives of former undergraduates; the past and present extracurricular (co-curricular and civic) experiences of such alumni; the attained post-graduate social and economic positions of former students; and the graduates' present satisfaction with, or attitudes toward Wayne University and the experiences it had afforded them during their undergraduate years.

Concurrently with the aforementioned purposes of graduate follow-up, this investigation was concerned with the confusing divergence of opinion encountered with respect to the place and importance of student activities participation in the University's academic preparation of undergraduates. Consequently, this study further sought the objective determination of existing differences between former student activities participants and non-participants during and after their student days.

The development and employment of a mailed questionnaire to a graduate population total of 2,037 male Liberal Arts degree recipients realized a sample of 1,092 respondents. The resultant study sample, 54% of the total graduate population for the four designated graduate periods (Early, Pre-War, War Years, and Recent), roughly comparable in number within each graduate group, permitted both inter-group and intra-group per cent analyses.

Certain conclusions with regard to male Liberal Arts graduates of Wayne University, supported by the examination and analysis of the study sample's tabulated questionnaire response, were drawn as: (1) general factual information of post-graduate outcome; (2) value judgments currently held by the alumni respondents; and, (3) discernible differences between former student activities participants and non-participants during their undergraduate days and in present post-graduate life.

Conceived in the hope of contributing to Wayne University's institutional direction through an increased understanding of the life outcomes of male Liberal Arts graduates, this study realized a sizeable amount of factual post-graduate information, a number of important graduate value judgments regarding undergraduate experiences, but few statistically-significant differences between former undergraduate student activities participants and non-participants.

No statistically-significant differences were found to exist between former student activities participants and non-participants in regard to: (1) substantial retention of graduates in Detroit and the State of Michigan; (2) high incidence of undergraduate self-support; (3) substantial earned annual incomes; (4) predominance of professional occupational endeavors; (5) relationship between planned undergraduate vocational preparation and current employment; (6) substantial graduate satisfaction with their academic preparation; and, (7) the favorable disposition of a decided majority toward both their own re-attendance and their children's enrolment at Wayne University for undergraduate study.

Significant differences between former student activities participants and non-participants, but two in number, were: (1) the greater inclination of former participants toward post-graduate civic and community activities participation;

and, (2) a more favorable attitude of former participants toward undergraduate student activities participation.

In view of these findings, then, the controversy and extreme positions sometimes encountered with respect to questioning the relative importance of the University's academic and student activities programs appear unwarranted. Generalizations, advanced in defense of either extreme position, collapse in consideration of the reported comparable graduate outcome of former activities participants and non-participants. Though a sizeable majority of all graduates included in this study clearly favor undergraduate student activities participation, it is evident that their judgment is predicated upon an acceptance of such co-curricular activities as integral to the total educational program of the University.

398 pages. \$5.10. Mic 56-2552

THE ROLE OF THE NEBRASKA STATE DEPARTMENT OF EDUCATION IN PROVIDING SCHOOL PLANT SERVICES

(Publication No. 17,589)

Floyd Gerald Parker, Ed.D.
The University of Nebraska
Teachers College, 1956

Adviser: Merle A. Stoneman

The Purpose and Procedure of the Study

The Purpose of this study was to evaluate the school plant activities in the State Department of Education and strive to establish a firm foundation for the future involving organization policies, and basic criteria in order that leadership and service in the area of school plant activities may be provided.

To accomplish these objectives, the following procedures were used:

- (a) The literature in the field of school plant services at the state level was reviewed.
- (b) Questionnaires were sent to one hundred and eighty school administrators and members of boards of education in an effort to evaluate existing practices and to indicate the needs for the expansion and improvement of present services.
- (c) The school plant services in the forty-eight state departments of education were studied with regard to authorization, organization and personnel, and for types of services rendered and the controls exercised.

The Results of the Study

The study revealed that education is a state function which has been delegated by statute and by legislative action to the state department. Such authority is primarily supervisory and regulatory, however, this does not necessarily relieve the local boards of education of their responsibility for the planning and construction of school facilities. Powers delegated or assumed at the local level not only require a satisfactory working relationship, but

also need leadership from the state level as well. To provide leadership at the state level, long term plans should be encouraged which involve policies and provide an opportunity through services which are stimulating, challenging and practical at the local level.

Recommendations

The following recommendations are intended to reflect the role of the Nebraska State Department of Education in providing school plant services. It was recommended that:

- I. The School Plant Section operate primarily in the roles of leadership and service to the local administrative school officials.
- II. The School Plant Section be authorized to develop basic criteria, as a part of the total accreditation program for the planning and construction of school facilities.
- III. All recognized schools desiring to retain recognition or to become qualified as an accredited school must submit plans to the State Department of Education for purposes of "review" in accordance with the basic criteria.
- IV. The State Department of Education continue its cooperative working relationship with the Teachers College of the University of Nebraska in administering and conducting school surveys or research at the local and intermediate level.
- V. The cooperative working relationship within the staff of the State Department of Education be continued and expanded.
- VI. The School Plant Section in the State Department of Education, with the aid of recognized authorities and advisory committees, develop and distribute printed materials as they relate to the adopted basic criteria.
- VII. Sufficient personnel and office space be provided in the School Plant Section of the State Department of Education for the development and administration of the school plant program as approved by the State Board of Education.
- VIII. The State Department of Education acquire facilities for microfilming building plans and that a file of all final site and building plans be maintained in the state office.
- IX. The State Department of Education sponsor and/or co-sponsor an annual School Buildings Clinic on a regional basis.
- X. The State Department of Education continue to cooperate with such organizations as the State School Boards Association, the Nebraska School Administrators Association, the Nebraska State Education Association and the Nebraska Custodial Association in the organization and promotion of activities relating to the continued improvement of school facilities.
- XI. Legislation be encouraged which would require, for purposes of health and safety, that all school facilities be designed and the construction supervised by an architect registered in the State of Nebraska. 174 pages. \$2.30. Mic 56-2553

MILITARY PROBLEMS FACING HIGH SCHOOL BOYS

(Publication No. 18,189)

Oliver LaVerne Rapp, Ed.D.
University of Illinois, 1956

This field study of military-associated problems facing older high school boys had three purposes:

- a. To find out what military-associated problems are now being or will be encountered.
- b. To find out which of these problems are, and which are not of concern.
- c. To point out the practical implications of these findings for pre-induction guidance.

Seven steps were necessary. First, the development of a tentative 244 question or problem checklist. Second, securing ratings and soliciting problems on a trial run of this checklist with older high school boys and officials competent to deal with their service problems. Third, editing the solicited problems and again securing boys' and officials' ratings. Fourth, keying the final checklist of 275 problems to IBM cards to test eight hypotheses. Fifth, surveying a random sample of secondary schools with the checklist. Sixth, machine scoring the IBM cards to test each hypothesis. Lastly, indicating implications for pre-induction guidance.

Nearly 3,000 older high school boys in 56 schools from 30 states participated. Two of the hypotheses were affirmed, six were not. The findings bearing on the hypotheses were:

1. That college bound boys are typically more concerned over military service than those in other curricula.
2. That there is no statistically significant difference between the military concerns of boys having well defined educational plans and those without such plans.
3. That the differences of concern over military service among boys in the low, middle, and high socio-economic groups are not statistically significant.
4. That boys living in the midwestern states are more concerned over military problems than those living in the seaboard states.
5. That there is no statistically significant difference between the concerns of boys living in the larger cities and those living in the smaller towns.
6. That boys living remote from military installations are more concerned over military problems than those living near such installations.
7. That boys not having friends or relatives in the service are more concerned over military problems than those without such associations.
8. That there are no statistically significant differences among the military concerns of boys who have not had ROTC training, those who have had or who are now taking such training.

Forty-one problems were of concern to one-third or more of the boys. These problems relate to the first contact boys have with their draft boards, call to service, en-

listing, and choice of branch of service.

The 112 problems indicated by between a third and a fifth of the boys deal with college associated problems, deferments, basic training, pay, allowances, and careers in the Armed Forces.

To begin a pre-induction guidance program in respect to these 153 problems, about all that needs to be done is to provide the needed help and to make this known; i.e., to secure the pertinent printed materials, motion pictures, slides, and recordings and to make these available in a military reference corner in the library; to provide well informed speakers on Selective Service, the Armed Forces, and college counselors as panelists for group discussions; and to appoint a qualified member of the faculty as the military guidance counselor. It is desirable to involve PTA representatives, student council officials, and war veteran faculty members in the planning sessions.

One hundred twenty-two problems were of concern to fewer than one-fifth of the boys. These encompassed items dealing with the National Guard, playing in the service bands, ministerial students, high school work, patriotism, and the need for a large military force now. For these problems, it will be necessary to begin by building readiness through conditioning youth to their new citizenship responsibility of service in the Armed Forces through accurate information, sympathetic understanding, and wise counseling.

176 pages. \$2.30. Mic 56-2554

THE EMERGING ROLE OF VOCATIONAL-TERMINAL EDUCATION IN THE PUBLIC COMMUNITY COLLEGES OF MICHIGAN

(Publication No. 17,165)

Douglas Roland Sherman, Ed.D.
Wayne University, 1956

This study involved two fundamental ideas: first, the determination of the status of vocational-terminal education in the public community colleges of Michigan, and, second, the evaluation of that status to determine what direction future growth should take. The over-all purpose, then, was to determine the emerging role: the existing status plus future development.

The determination of the status was accomplished through a three-fold approach. First, all the available literature was thoroughly reviewed to obtain some broad generalizations relative to the place, scope, and function of vocational-terminal education in the total program of the community college. This was carried on without reference to the specific role, scope and function of vocational-terminal education in the total programs of the Michigan community colleges, but was done to indicate national trends, standards and practices. Second, the 1954-55 catalogs of the Michigan community colleges were examined to note the vocational-terminal curricula that were currently offered, the types of diplomas granted, and the educational background of the instructors in the various vocational-terminal curricula. Third, each community college participating in this study was visited, the chief administrative officers and selected instructors were interviewed, and, in addition, the information gleaned from the catalogs was checked for accuracy.

The second phase of this study, the evaluation of the status, was accomplished through a four-step approach. First, a booklet, Vocational-Terminal Education in the Public Community Colleges of Michigan, was published to report the status aspects of this study. Second, ninety-one reviewers were selected from leadership personnel in the fields of education, commerce and industry, labor and agriculture. Third, through a content analysis approach, twenty-three topics were identified in the booklet, and a check list based on these topics was developed. Fourth, the reviewers were then asked to read the status booklet and report their responses and opinions on the check list. Sixty-one of the ninety-one selected reviewers responded. Naturally, the check list allowed for comments and whatever fine distinctions the reviewer might care to make. These opinions were then organized and analyzed and became the statement of what the emerging role should be.

The more important results were these:

1. There was a strong tendency to force any occupational training program into the confines of a two-year, structured, educational framework, rather than adjusting the length of the training to the needs of the occupation.
2. The vocational-terminal offering was not as broad as might be desired. The majority of all curricula was in the area of business education; hence greater emphasis must be given to developing the other areas. Cooperative work-study programs, too, need increased emphasis.
3. Vocational-terminal curricula need to be implemented on the basis of community need as determined through some form of objective evaluation.
4. Many curricula seemed vaguely oriented with regard to specific occupational objectives.
5. The enrollment in vocational-terminal education in the Michigan community colleges varied widely.
6. Advisory committees, where not used, should be implemented.
7. The efficacy of follow-up and placement procedures seemed questionable.
8. The instructors in the vocational-terminal area were apparently well qualified, both from the standpoint of occupational competence and the standpoint of professional preparation.
9. Because of the difficulty in certifying teachers, the Michigan certification procedures for community college instructors should be reappraised and revised accordingly.
10. Most Michigan community colleges did not have adequate physical plant facilities nor administrative staff personnel.

305 pages. \$3.95. Mic 56-2555

A STUDY OF THE ORIGIN, DEVELOPMENT, AND TRENDS OF SELECTED COMMUNITY COLLEGES OF MICHIGAN

(Publication No. 17,168)

William James Adrian Valade, Ed.D.
Wayne University, 1956

This study investigated the growth and development of four geographically selected community colleges in Michigan. A questionnaire seeking factual information was sent to all fourteen deans of junior or community colleges of Michigan as well as to four directors and former deans. An opinionnaire was sent to the fourteen superintendents of

the same school districts and also to eight superintendents of counties surrounding the college at Traverse City. In all forty copies were distributed and twenty-six were returned, or a percentage of sixty-five. The great majority of returns contained usable material. All the community colleges in Michigan except two (Flint and Grand Rapids) were represented in the replies. Each of the selected community colleges at Bay City, Traverse City, Highland Park, and Dearborn were represented by at least two returns. Additional data for the selected colleges were obtained by personal interviews with present and former deans and by personal observations of the selected colleges and communities. A conference was also arranged with representatives of the Michigan Department of Public Instruction. Other sources of information were the catalogs of each selected community college and miscellaneous bulletins as well as annual, statistical, and survey reports.

The analysis of data for each local study revealed information concerning the origin of the college and the development of the curriculum into its present form. The current program was analyzed in terms of types of courses offered. This revealed the percentage of the total courses in the vocational, avocational, civic-cultural, and academic areas. The results showed trends identifying progress toward the community college ideal.

The conclusions of the study indicated that in three of the colleges studied the origin was found in the professional leadership of the schoolmen who advanced the cause to the Board of Education which recommended, under Act 146, P.A. 1917 (Michigan), the establishment of a junior college. The fourth college at Traverse City appeared to have its origin in a social movement of lay people with the continued assistance and direction of the educational leaders of the community. The original purposes of the college reflected in a large measure the general educational philosophy in existence at the time of origin and the administrative leadership during the founding period. In most cases the original purpose was to provide university parallel courses.

The development of the curricula expanded most rapidly during and after World War II. Terminal and vocational programs were begun or expanded. The adult education program was also a factor in this development. In Bay City and Dearborn this program became part of the community college. At Highland Park the adult education program became a separate division in the school system after a short period of fusion between 1948-50. At Traverse City the adult education program was incorporated into the community college at the time of origin. Now the selected colleges have three types of programs, (1) liberal arts (2) terminal (vocational-avocational) (3) general interest (civic-cultural).

The trends appeared to indicate that these colleges were all developing to some extent toward the community college ideal. They had relatively strong services in the areas of refresher and short courses as well as in adult education programs. The greatest drawbacks toward achieving this goal seemed to be the lack of enough use of community surveys, a lack of use of advisory committees, a failure to develop more integration with local high schools, and a failure to develop more adequate cooperative programs. On the whole, however, the colleges appeared to be alert to potential shifts in community needs and increasingly aware of what changes should be considered and what goals should be attained.

275 pages. \$3.55. Mic 56-2556

EDUCATION, HISTORY

EDUCATION IN KOREA 1945-1955

(Publication No. 18,314)

Donald Kendrick Adams, Ph.D.
The University of Connecticut, 1956

The purpose of this study is to provide a descriptive analysis of the major developments of Korean education from 1945 through 1954. This analysis includes an examination of the goals, organizational structure and administrative and teaching practices as they evolved during the period under consideration.

The types of source material examined include: documents from agencies of the United States, United Nations and the Korean Ministry of Education; educational and general histories of Korea and the Far East; relevant reports and pamphlets from Korean educational and social institutions; and personal studies of Korean and American scholars. Much of the material gathered was unpublished and written by Koreans or foreigners intimate with a particular period or phase of Korean education.

The historical method of research, using both primary and secondary source material was employed throughout the study. In the presentation of the research findings, essentially a chronological pattern was followed with an introductory chapter being added to show the effect of earlier forces which continued to influence Korean education. The ten years under consideration were divided into four periods, chosen because of the significant educational changes in each. During the first period, 1945-1948, that portion of Korea known as South Korea was under the control of the United States Military Government and thus Korean educators were brought into direct contact with American educational philosophy and methods. The second period includes the two years, 1948-1950, when Koreans for the first time in nearly half a century had an opportunity to control their own institutions. The Korean War, 1950-1953, with its destruction of educational facilities, displacement of students and reduction of school faculties, comprises the third period. In the final, or post-war period, the attempts at educational reconstruction and rehabilitation are considered.

Korean education between 1945 and 1955 in many respects resembled a laboratory experiment wherein new ideas were being tested and old theories discarded. During these troubled years, Korean schools began to change from institutions geared to the wants and needs of another nation to institutions designed to serve an independent people. The obstacles to overcome, namely a heritage of traditional Chinese philosophy antithetical to progressive educational thought, thirty-five years under complete domination of Japan and continued political instability, were indeed great. Increasingly, however, Koreans succeeded in identifying their political and social institutions with democratic goals. The National Educational Law promulgated in 1949 embodied principles of free, compulsory education and established a plan for local administration of education. Added emphasis on vocational education and increased attention to the individuality of students were two other modern educational practices to which Koreans became committed by law.

An appraisal of the Korean's progress toward the attainment of goals stated in their educational laws showed in 1954 both encouraging signs of advancement and exam-

ples of ineffectual action. By 1955 the number of educational institutions and the size of enrollments reached an all-time high, yet education was neither fully compulsory nor completely free. Progress of Korean teachers toward modern educational practices was frustrated by lack of basic educational research on Korean youth and further compounded by a superficial imitation of American methods. And, the elaborate educational self-government system existed only in the theoretical stage.

Korean education like other phases of Korean social and cultural life was in 1954 still in a stage of ideological transition. The foundation for lasting change appeared to have been laid, however, for Korean educators were becoming increasingly cognizant of the discrepancies between educational theory and practice.

328 pages. \$4.20. Mic 56-2557

SOME SOCIAL AND INTELLECTUAL INFLUENCES
IN THE DEVELOPMENT OF PUBLIC EDUCATION
IN MISSOURI 1865 TO 1900

(Publication No. 17,200)

Maynard Gregg Redfield, Ed.D.
Washington University, 1956

Chairman: Adolph Unruh

The primary purpose of the study was to determine the dominant social and intellectual influences which affected the development of public education in Missouri between 1865 and 1900 and to gain an understanding of the ways in which these influences affected public education in the state. Another purpose was to find the similarities and differences between social and intellectual influences in Missouri and those on the national level. An attempt was made to contribute to a better understanding of the inter-relationship between public schools and society.

The research techniques used were those generally associated with the historical method. A wide variety of both primary and secondary sources were used. The best sources were educational journals published in Missouri and annual reports of state superintendents, as well as reports from a number of city superintendents in the state.

Missouri differed from the South in establishing a complete system of public schools. It differed from the East and also other areas of the Middle West in giving restricted support to the public educational system. Restricted support of public education was largely due to the persistence of a Southern attitude toward education which was intensified by the resentments resulting from war and reconstruction. Other factors contributing to this tendency include agrarian economic distress and discontent, failure of schools to adequately meet rural needs, and the influence of private and parochial school interests.

All levels of public education were justified by school leaders and supporters as necessary to attain American citizenship objectives at both the national and local levels. An analysis was made of specific citizenship objectives and also of the types of curriculums and methods of teaching considered necessary to attain these objectives.

Public education in Missouri was greatly influenced by the rationale of business enterprise. A discussion was

given of the ways in which business values influenced the thinking of Missouri public school personnel about curriculum, educational objectives, and school administration.

One problem investigated had to do with analyzing how the methods and findings of science influenced curriculum, teaching methods, and educational philosophy in Missouri public schools.

One chapter was devoted to making an analysis of how conflicting intellectual currents of national significance influenced the course of public education in Missouri.

329 pages. \$4.25. Mic 56-2558

A HISTORY OF THE EARLY TEACHING OF AGRICULTURE IN SOUTH CAROLINA

(Publication No. 17,560)

Legrand Iris Yarborough, Ed.D.
The University of Florida, 1956

From the earliest times South Carolina was predestined to become an agricultural state being possessed of soils, climate, and other natural resources suitable to the development of an agricultural economy.

The chief aim of this study has been to describe the early development of agricultural education in South Carolina. The early institutions making contributions to the teaching of agriculture were grouped in order to facilitate the handling of the data.

Beginning as early as 1785, a group of agricultural societies and clubs sprang up in the State to promote the best interest of agriculture. At least six of these societies have been in existence for more than one hundred years and are still active today. These societies have filled a real need in the agricultural, economic and social needs of their communities. The work of these groups has generally been along the following lines:

1. They encouraged experimentation by offering premiums for superior products.
2. They encouraged better agricultural training.
3. They promoted wide reading and clear thinking through their publications.
4. They held fairs and encouraged the showing of the best specimens of their arts.
5. They furnished a forum where all the people of the State could be informed upon matters pertinent to agriculture.

The earliest educational institutions of the State did not contribute materially to the promotion of agricultural education. However, provisions were made, beginning as early as 1797, for some manual labor training in a few schools of the State. These schools provided training in practical agriculture, industrial arts and domestic science. In 1880, the teaching of agriculture at the college level was begun in connection with the State university. In 1889, Clemson College was established for the further provision of agricultural training. At the turn of the century, agricultural education was placed on a more practical basis through the cooperation of Clemson College and the United States Department of Agriculture. They provided a system

of practical agricultural instruction through Farmers' Institutes and Cooperative Farm Demonstration Teaching.

In 1886, the State Constitution provided for the teaching of a cultural type of agriculture as a part of the general curriculum of the public schools. This type of teaching was provided beginning around 1901 and steadily increased until 1917. During this period much agitation was heard for the introduction of vocational agriculture into the public schools of the State.

In 1917, legislation was enacted on both a national and State level to provide for the teaching of vocational agriculture in the public high schools of the State. Training was begun in 1917-1918 in thirteen high schools of the State. The teaching of vocational agriculture in the public high schools moved forward rapidly and today it is offered in every county of the State.

Certain general conclusions may be drawn from the results of the study:

1. Contributions to the early teaching of agriculture in South Carolina were made by a great number and a wide variety of institutions.
2. The work of the founding fathers of agricultural education in South Carolina was well done.
3. South Carolina is now providing a good state-wide system of vocational agricultural education.
4. There is a need for some expansion of the work.

160 pages. \$2.10. Mic 56-2559

EDUCATION, PHYSICAL

EVALUATION OF IMPROVEMENT IN GAIT OF CEREBRAL-PALSIED CHILDREN

(Publication No. 17,460)

Frank Joseph Bok, Ph.D.
State University of Iowa, 1956

Chairman: Professor Frank D. Sills

The purpose of this study was two-fold: first, to evaluate, by means of thirty-two measures and judges' in the gaits of a group of cerebral-palsied children; and second, to compare the one method of evaluation with the other. The measures and the ratings were obtained from motion pictures at the beginning and at the end of experiments based on programs of physical activities designed to emphasize conditioning, balance, co-ordination, and gait velocity.

On the basis of the thirty-two measures obtained at the beginning and at the end of the experiment, the following findings are reported: the gait patterns of ten subjects were more nearly normal at the end of the experiment than at the beginning; the gait patterns of four subjects were more abnormal at the end of the experiment than at the beginning of the experiment; and the gait pattern of one subject remained unchanged from the beginning to the end of the experiment.

On the basis of the ratings made by the judges, the following findings are reported: the gait patterns of thirteen

subjects improved during the experiment; the gait pattern of one subject retrogressed during the experiment; and the gait pattern of one subject was not changed during the experiment.

A comparison of (1) the evaluations assigned to the measures and (2) the ratings made by the judges indicates the following percentages of agreement relative to the appraisal of the gait patterns: the stance phase, 73 per cent; for the trunk, 53 per cent; for the arms, 60 per cent; and for the head, 60 per cent.

155 pages. \$2.05. Mic 56-2560

A STUDY OF MUSCULAR FITNESS OF IOWA CHILDREN AGES SIX THROUGH FIFTEEN

(Publication No. 17,462)

Doris Patterson Buxton, Ph.D.
State University of Iowa, 1956

Chairman: Professor M. Gladys Scott

The purpose of this study was twofold:

1. To describe the performance of Iowa school children between the ages of six through fifteen on thirteen tests purporting to measure muscular fitness in the main large muscle groups of the body which are primarily involved in fitness for daily living.

2. To compare the results of scoring the six Kraus-Weber Tests for muscular fitness by the pass-fail method with a type of scoring which is more differentiating.

The procedure was to collect data from 1057 children, ages six through fifteen, who were given thirteen tests designed to measure muscular fitness in the main large muscle groups of the body. Children were tested from three schools which had physical education programs and from three schools which had no physical education. The tests were designed to include a score identical to that which would have been obtained on the Kraus-Weber Test, to provide a more differentiating score on those same tests, and also to add arm and leg strength tests. Flexibility tests in addition to those provided by Kraus were added for the arm and shoulder girdle region and for the lower back.

The conclusions based on the data received from the subjects tested in this study were as follows:

1. In comparing results in the three Iowa City schools where the Kraus-Weber Tests were given in 1955 and 1956, the differences were small and were not treated statistically. Although there appeared to be a slight improvement in the scores made on the strength tests, there was no definite pattern of improvement in the flexibility test scores.

2. In general the girls were more flexible than boys but this was not always true in the older age ranges studied here.

3. Boys and girls who have physical education in their school program did better on the Kraus-Weber Test of both strength and flexibility than those children who did not have physical education.

4. Iowa children do not compare favorably with the Indiana children nor the Kraus group on the Kraus-Weber Test.

5. The use of a type of scoring which differentiates at all levels of ability produces more meaningful data than the Kraus-Weber type of scoring.

6. The children did better on the abdominal and upper back tests as they grew older but not as well on the psoas and lower back tests. This is doubtless associated with the growth factor. Due to the difference in the averages obtained on these tests, it would seem that one sit-up for Test 1 and a 10 second time limit on Tests 4, 5, and 6 should not be very meaningful when applied to both sexes at any age.

7. A slight warm-up improves flexibility and performance in this test. It may even make the difference between passing or failing the Kraus-Weber Test.

8. Physical education programs in the schools used in this study do not appear to benefit the girls as much as the boys as far as the results are measured by muscular fitness tests.

9. Attitude may account for level of performance on muscular fitness tests. The noticeable difference in attitude in one school which had a good physical education program may have accounted for a statistically poorer showing for those boys on two strength tests in comparison to the better attitude of the boys in other schools even if they had not had physical education.

103 pages. \$1.50. Mic 56-2561

PROCEDURES FOR RECONSTRUCTING THE COURSE OF STUDY IN PHYSICAL EDUCATION FOR ELEMENTARY SCHOOLS IN THE PHILIPPINES

(Publication No. 17,471)

Adina Rigor Ferrer, Ph.D.
State University of Iowa, 1956

Chairman: Professor Elizabeth Halsey

Physical education in elementary schools has a prominent place in the education of boys and girls in Europe and the United States. Research studies, teacher training programs, modern equipment and facilities, resource materials, and other teaching aids are evidences of the support given to physical education. To judge by these marks of progress places the physical education program in the Philippines very low on the scale.

In 1952, a course of study in physical education for elementary schools was issued by the Bureau of Public Schools. This course of study was arranged and adapted from various sources - from courses of study and books in physical education describing American and European programs.

This study has attempted to suggest procedures for the reconstruction of the Philippine course of study in physical education for elementary schools issued by the Bureau of Public Schools.

A brief review of the geographic, ethnographic and historical background of the country shows the influence of so many cultures - Spanish, American, Japanese, Chinese, Indian, Malayan, Indonesian and others. While there are many national characteristics, there are probably as many regional and provincial differences depending on the in-

fluence of various cultures on the different regions of the islands. These facts make it evident that environmental factors must be considered in any course of study suitable for Filipino children.

Consideration of elementary education in the Philippines and an evaluation of the present course of study based on expert opinion of several American authors point to the need for revising this Philippine course of study.

A review of procedures used in successful projects in curriculum revision in the United States at the state and municipal levels shows that these projects were planned to secure wide-spread participation of persons directly or indirectly concerned in the program.

The use of similar procedures in the Philippines as it might be made at the national, provincial and municipal levels is discussed. These procedures suggested are such that the philosophy, the aims, major concepts and types of learning activities are established at the national level, whereas the detailed content, specific student activities and adaptations are accomplished at the municipal level. All these responsibilities at the national, provincial, and municipal levels are accomplished through the cooperative planning of teachers, administrators, laymen, and students. On the basis of modern practices in the United States, guides to course of study construction for participating committees are included. The point of view is taken that the content of the course of study should provide for the developmental needs of children and that their environmental needs and resources should also be considered.

179 pages. \$2.35. Mic 56-2562

A FILM ON FUNDAMENTAL PROCEDURES IN PHYSICAL EDUCATION FOR ELEMENTARY SCHOOL CLASSROOM TEACHERS

(Publication No. 17,478)

Blanche Elizabeth Owens, Ph.D.
State University of Iowa, 1956

Chairman: Professor M. Gladys Scott

This study is concerned with the in-service training of elementary school classroom teachers and the training of prospective elementary classroom teachers in the field of physical education. In order to provide a training experience for these groups, a 16 mm., sound motion picture and film guide were constructed and appraised.

Basic information for the content of the script for the film was gained by inquiring of professional persons who were engaged in teaching elementary physical education; perusing the literature in the fields of elementary physical education, audio-visual education and teacher training; previewing similar types of teacher training films in other educational fields. From these sources a check list was compiled and sent to individuals who were highly experienced in teaching or administering the elementary physical education program or who had past experience in producing films in the field of physical education. In so far as was possible technically, the script was made to follow the recommendations of the results of this survey.

The filming was accomplished at the Henry Roe Cloud Elementary School in Wichita, Kansas. The regular staff and students of the school were the subjects for the motion

picture. The editing and producing of the sound track was done in cooperation with the Motion Picture Production Department at the State University of Iowa.

On completion of the production, the film was appraised for its technical mechanics, content and usability by groups of staff members and students at the university. Advanced cinematography students and their instructor rated the film as to its technical mechanics. Their general rating was above average for most factors. The women staff members and graduate students of the physical education department compared the content of the film as produced with the content which was recommended by the experts in the preliminary survey. They determined that for the most part the film was in accordance with the recommendations in regard to content.

Two groups appraised the film for usability. One was composed of professional elementary classroom teachers who were attending an extension class at the university and the other was made up of elementary education major students who were in attendance at the university. Their opinions indicated that the film should be useful for the in-service training experience of classroom teachers and for the training of prospective elementary teachers.

As a result of the study the following recommendations were made for further studies:

1. That teacher training films be produced for specific areas such as folk dancing, stunts and sports for elementary physical education.
2. That additional teacher training films in elementary physical education be produced in regard to teacher planning, organization and evaluation.
3. That teacher training films be produced to show how teachers are aided in their teaching by consultants, college classes and conventions.
4. That teacher training films in elementary physical education be planned and produced for particular local situations.
5. That consultants, teachers and principals produce their own films for the teaching of elementary physical education.

128 pages. \$1.70. Mic 56-2563

CONSTRUCTION OF A FILM AS AN AID FOR TEACHERS OF PRIMARY PHYSICAL EDUCATION

(Publication No. 17,482)

Lorena Ray Porter, Ph.D.
State University of Iowa, 1956

Co-chairmen: Professor M. Gladys Scott
Professor Elizabeth Halsey

The purpose of this study was to construct a film for pre-service and in-service education of teachers of primary physical education. As a preliminary step, a brief study was made of the use of activity time in first and second grades of three schools in order to find answers to the following questions: 1) How much pupil activity are we getting in physical education classes? 2) Do different forms of physical education give perceptibly different amounts of pupil activity?

In order to answer these questions, one hundred twenty-two observations, using a timing technique, were made in three cooperating schools. The purposeful activity of

selected subjects was recorded in each form of physical education participated in during the entire class period. In this study, "purposeful activity" refers to movement experiences which satisfy the child's desire for activity in a manner consistent with the goals adopted through teacher-pupil planning. The child's actual participation was timed, excluding periods of inactivity while waiting a turn, standing in a circle, listening to directions, etc. The conclusions, as based on these observations, are as follows:

1. Forms of physical education differ significantly in their "activity yield" for children. From the evidence secured in this study, games rank low in the amount of purposeful activity engaged in by certain children. Dance and self-testing activities were high in "activity yield."
2. The range of variability observed in all forms of physical education indicates the need for careful selection of activity, materials, and organization.
3. High amounts of purposeful activity were observed in lessons based on those forms of physical education which permit the child to participate as an individual with a maximum of self-direction and creativity. Low amounts of purposeful activity were observed in lessons which were based exclusively on games.
4. A direct relationship between the amount of equipment and the purposeful activity of children was apparent throughout the observations.

The need to improve the use of activity time as shown by the wide range in "activity" in various forms of physical education, and in various class periods, influenced the decision to plan the film in terms of the following criterion: to illustrate methods, materials, and forms of physical education which encourage a high amount of purposeful activity for children. The sub-title "Best Use of Activity Time" was selected to focus attention on the criterion.

The series of lessons to be shown in the film were planned in cooperation with the supervising teachers of physical education of the University Elementary School and St. Mary's School of Iowa City. The use of the criterion was based on assumptions consistent with commonly accepted psychological and scientific principles of teaching. These influenced the methods and techniques employed in the lessons which included the use of pre-planning and evaluation as a means of guiding children in the expansion of desirable goals; provision for individual differences through a rich and challenging environment for activity in which each child is encouraged to practice at his own level of development; motivation through exploration and problem solving situations; guidance of children toward self-directed activity.

Self-testing activities, movement exploration, rhythmic dramatization, and games were included in the lessons to suggest the scope of a balanced program. Locally constructed apparatus which could be adapted to a playroom or playground was used in order that the situations might seem feasible for the small school.

The film was produced by the Bureau of Audio-Visual Instruction, Extension Division, State University of Iowa. Subjects were from St. Mary's School, Longfellow School, and University Elementary School of Iowa City, and Graham School of Morse, Iowa. Supervising teachers of physical education of the University Elementary School and St. Mary's School taught the demonstration lessons.

74 pages. \$1.50. Mic 56-2564

ELECTROMYOGRAPHIC STUDY RELATIVE TO MOVEMENTS OF THIGH AT HIP JOINT

(Publication No. 17,496)

Charles Paul Wolbers, Ph.D.
State University of Iowa, 1956

Chairmen: Professor Charles H. McCloy
Professor Max D. Wheatley

The purpose of this study was to investigate, by means of electromyography, the function of the long head of the biceps femoris, the rectus femoris, the semitendinosus, and the tensor fasciae latae in movements of the thigh at the hip joint. The data were collected by means of a Grass electroencephalograph. Fifteen college men served as subjects.

The movements of the thigh, and the muscles that registered action potentials of at least medium amplitude, appear in the following tabulation, in which x's not encircled indicate that the muscle recorded action potentials in at least two thirds of the movement and the encircled x's indicate that the muscle recorded action potentials in only one third of the measurement.

Movement of Thigh	Biceps Femoris	Rectus Femoris	Semi- tendinosus	Tensor Fasciae Latae
Extension, with leg flexed			x	
Extension, with leg extended	x	x	x	
Flexion, with leg flexed		x		x
Flexion, with leg extended		(x)		x
Extension-adduc- tion with leg flexed	(x)		x	
Extension-adduc- tion with leg extended	(x)	(x)	x	
Flexion-adduction, with leg flexed		(x)		x
Flexion-adduction, with leg extended		(x)		x
Extension-abduc- tion, with leg flexed	x			x
Extension-abduc- tion, with leg extended	(x)		x	(x)
Flexion-abduction, with leg flexed		x		x
Flexion-abduction, with leg extended		(x)		x
Eversion, with leg flexed	(x)			
Eversion, with leg extended	x			

Movement of Thigh	Biceps Femoris	Rectus Femoris	Semi-tendinosus	Tensor Fasciae Latae
Inversion, with leg flexed				x
Inversion, with leg extended				x

The findings, in general, compare favorably with electromyographic findings reported by Wheatley and Jahnke¹ and by McCloy.² 55 pages. \$1.50. Mic 56-2565

1. Max D. Wheatley and William Dean Jahnke. "Electromyographic Study of the Superficial Thigh and Hip Muscles in Normal Individuals," *Archives of Physical Medicine*.

2. C. H. McCloy, "Some Notes on Differential Actions of Partite Muscles," *Research Quarterly*, December, 1946.

EDUCATION, PSYCHOLOGY

AN EVALUATION OF PHYSICS AND CHEMISTRY INSTRUCTION IN CONNECTICUT PUBLIC SECONDARY SCHOOLS

(Publication No. 18,316)

Charles Joseph Bannon, Ph.D.
The University of Connecticut, 1956

A representative sample of Connecticut public secondary-school pupils enrolled in physics and chemistry courses was obtained for the purpose of evaluating physics and chemistry instruction in the Connecticut public secondary schools.

The *Dunning Physics Test - Form AM* and the *Anderson Chemistry Test - Form AM* were administered to the physics and chemistry pupils respectively. The achievement of the Connecticut pupils, who represent an unselected group of secondary-school pupils, was compared with the achievement of the test publisher's highly-selected normative group. Differences in achievement in physics and chemistry by certain selected pupil and school characteristics were also analyzed. The following techniques were used where applicable: (1) graphical representations, (2) T tests, and (3) correlation coefficients.

From the evidence obtained, the following findings are presented:

1. The test publisher's highly-selected normative group attained a higher level of achievement in physics than did either the total Connecticut group or those enrolled in the college preparatory curriculum. These differences were significant at the one-tenth percent level of confidence.

2. Connecticut physics students enrolled in the scientific curriculum attained a level of achievement in physics not significantly different from that of the highly-selected normative group.

3. Connecticut public secondary-school pupils enrolled in chemistry courses, achieved, as a total group, at a level not significantly different from the test publisher's highly-selected normative group. Connecticut public secondary-

school pupils enrolled in the college preparatory and scientific curricula achieved at a level higher than that of the normative group. These differences were significant at the five-tenths and the one-tenth percent levels of confidence respectively.

4. Differences in achievement in physics, significant at the one-tenth percent level of confidence, were found in favor of boys; twelfth grade students; pupils in the older age group; pupils enrolled in a college preparatory curriculum; those who study four or more semesters of science other than physics; those who also study chemistry; and those enrolled in large schools in comparison with contrasting groups. Per capita cost of education in the school was found not to be a significant factor in pupil achievement in physics.

5. Differences in achievement in chemistry, significant at the one-tenth percent level of confidence were found in favor of boys; pupils in the younger age group; those enrolled in a college preparatory curriculum; those who study four or more semesters of science other than chemistry; those who also study physics; those enrolled in schools with large enrollments; and those enrolled in schools whose per capita cost is high in comparison with contrasting groups. Grade was found not to be a significant factor in pupil achievement in chemistry.

6. Achievement in physics and chemistry varied by the location of schools by county. However, these differences were not tested for significance.

From the results obtained, the following conclusions are drawn:

1. Connecticut public secondary-school physics students who are boys; students who are in the twelfth grade; students who are in the upper age group; students who are enrolled in a college preparatory curriculum; students who study four or more semesters of science other than physics; students who also study chemistry; and students who attend schools with large enrollments attain, on the average, a higher level of achievement in physics than do those who are not in the above categories. Achievement in physics does not vary significantly in relation to per capita cost.

2. Connecticut public secondary-school chemistry students who are boys; students who are in the lower age group; students who are enrolled in a college preparatory curriculum; students who study four or more semesters of science other than chemistry; students who also study physics; students who attend schools with large enrollments; and students who attend schools whose per capita cost is high attain, on the average, a higher level of achievement in chemistry than do those who are in the opposite categories. Achievement in chemistry does not appear to vary by the grade in which it is studied.

3. Physics and chemistry instruction in Connecticut public secondary schools appears to be providing satisfactorily for intellectual growth of the students in these two science courses, as judged by the criteria of the tests used.

153 pages. \$2.05. Mic 56-2566

EDUCATION, TEACHER TRAINING

DEVELOPING A GUIDEBOOK OF PROFESSIONAL LABORATORY EXPERIENCES FOR SUPERVISING TEACHERS AND STUDENT-TEACHERS AT THE UNIVERSITY OF SOUTH DAKOTA

(Publication No. 17,587)

Cecil Kipling, Jr., Ed.D.
The University of Nebraska
Teachers College, 1956

Adviser: Merle A. Stoneman, Ph.D.

The Purpose and Procedure of the Study

The purpose of this study was to determine what professional laboratory experiences should be provided for those students doing student-teaching at the elementary school level and to prepare a guidebook for the use of supervisors and student-teachers that would include suggested activities directed toward providing those desirable laboratory experiences.

A survey of the literature in the field was made and a check-list of professional laboratory experiences was developed. This list contained 129 professional laboratory experiences classified in the following six categories:

1. Experiences Which Help Teachers Understand Children
2. Experiences In Planning And Guiding Pupil Activities
3. Experiences Involving Teaching Techniques And Methods
4. Experiences In Handling Routine Classroom Duties
5. Experiences In School And Community Activities
6. Experiences Related To Professional Growth

The check-list was submitted to a group of elementary teachers, a group of elementary principals and supervisors and a group of college staff members for evaluation.

As a result of this evaluation, each item on the check-list was assigned an index. A mean index of 3.50 which indicated a rating midway between "I believe that this activity is important and that considerable stress should be given to it in student-teaching" and "I believe that this activity is somewhat important and that some stress should be given to it in student-teaching" was obtained for 101 of the items on the check-list. These items were selected for inclusion in the Guidebook.

The Guidebook was written for use by supervising teachers and student-teachers during the 1955-1956 school year. It consisted of 174 pages and was divided into seven sections. Section One was devoted to general instructions concerning the student-teaching program at the University of South Dakota and the six subsequent sections were devoted to the six general classifications of activities stated above. An overview which indicated the importance of the experience and some of the major concepts involved, suggestions to the student-teachers and supervising teachers in the form of questions or problems and selected references were presented for each of the professional laboratory experiences included in the Guidebook.

The Results of the Study

The following statements summarize the principal conclusions derived as a result of evaluating the effectiveness of the Guidebook:

1. An increase in the number of professional laboratory experiences provided for student-teachers has resulted from the use of the Guidebook.

2. The Guidebook has value in that the suggested activities serve as a basis for the weekly conferences with the student-teachers.

3. The Guidebook is especially helpful in orienting new supervising teachers relative to the student-teaching program.

4. The assigned activities in the Guidebook provide the supervising teachers and college supervisors with a more comprehensive and accurate evaluation of the progress and growth of the student-teachers.

5. The amount of time spent in the cooperating schools by the student-teachers needs to be increased if all of the experiences suggested in the Guidebook are to be provided.

6. There is a need for an in-service program for supervising teachers. This program should be developed through the cooperative efforts of the Department of Elementary Education and the cooperating schools. This in-service program should endeavor to bring about a clearer understanding of the professional laboratory experiences included in the Guidebook and should strive to discover means by which they might be provided more adequately for the student-teachers involved in the program.

375 pages. \$4.80. Mic 56-2567

THE STATUS OF THE MUSEUM ON COLLEGE AND UNIVERSITY CAMPUSES HAVING ACCREDITED SCHOOLS OF EDUCATION

(Publication No. 17,479)

Cecilia H. Peikert, Ph.D.
State University of Iowa, 1956

Chairman: Professor James B. Stroud

This study had as its purpose an investigation of the role the educational museum plays in teacher training institutions of the United States. It brought together information regarding museums on campuses having accredited schools of education--their organization, administration, and programs--which should be helpful to those working in or with such a museum.

The method of procedure involved the compilation of material by means of brochures, personal correspondence, visitation, and a questionnaire sent to 144 museums at 127 accredited schools of education.

Through the questionnaire facts were discovered relative to these areas: museum personnel, housing, budget, administration, specialization, educational philosophy, accession policies, services, participation in teacher-training program, museum courses, publications, and handicaps to the program.

Detailed studies were made of ten museums selected from the total group on the basis of program activity, but encompassing a variety of types, sizes, and locations. These museums were Teaching Materials Service, Ball State Teachers College, Muncie, Indiana; Central Missouri State College, Warrensburg; Detroit Children's Museum, Wayne University, Detroit, Michigan; Exhibits Section,

University Museums, University of Michigan, Ann Arbor; Natural History Museum, University of Minnesota, Minneapolis; University Museum, University of Pennsylvania, Philadelphia; Panhandle-Plains Historical Museum, West Texas State College, Canyon; Ohio State Museum, Columbus; Western Kentucky State College, Bowling Green; Illinois State Normal University, Normal.

From the compilation of evidence presented the writer made the following observations:

1. Museums sponsored as independent units for the use of the entire college are relatively rare on teachers college campuses; many are of the departmental type. Universities generally have independent museums.

2. College and university administrative personnel have not been made generally aware of the part museums can play in the educative process as demonstrated by the lack of interest, financial support, housing, and staff in many of the museums studied.

3. Many noteworthy and valuable collections held by this group of museums could enhance the educational programs at their schools.

4. No general policy exists in most colleges and universities regarding qualifications of museum staff members for this particular work.

5. A large percentage (almost 70) of the persons charged with responsibility for a college museum have other duties which may take up to one hundred per cent of their time.

6. The difficulty of obtaining trained personnel for museum work is partly due to the lack of university courses available in this area.

7. While some standard methods of making museum materials useful to student teachers are followed by many museums, there exist many relatively unexplored areas of service.

8. A number of college and university museums have evolved sound educational programs which might serve as examples for other schools.

The writer recommends that an educational program be planned whereby educational leaders can be made aware of the potentialities present in museums. This might be accomplished through publications issued by the museums or by articles in educational journals prepared by properly trained museum personnel. Standards of procedure could be evolved by these museums through organization of their members, and through professional publications circulated among them presenting common problems and possible solutions. It is further recommended that personnel be investigated and revised. An inter-college loan program is suggested to widen the offerings of individual museums. Finally, schools of education and museums on their campuses need to be encouraged to offer further opportunities to student teachers to become acquainted with museum resources and services. 248 pages. \$3.20. Mic 56-2568

THE IN-SERVICE TRAINING OF SCHOOL PERSONNEL PROVIDED BY SOUTH DAKOTA STATE SUPPORTED INSTITUTIONS OF HIGHER LEARNING

(Publication No. 17,590)

Frederic E'John Petersen, Ed.D.
The University of Nebraska 56
Teachers College, 1956

Adviser: Merle A. Stoneman

The Purpose and Procedure of the Study

The purpose of this study was an analysis of the strengths and weaknesses of the programs of in-service training for school personnel sponsored by the six South Dakota state supported institutions of higher learning which offer teacher training. A secondary purpose was to make recommendations for improvement in the types, amounts, and effectiveness of the services provided and to suggest improvements on a state-wide basis. The study included a survey of the literature relating to in-service education of school personnel. It proposed seven criteria which were used as a basis for the review of the in-service education programs of state supported colleges and universities in South Dakota. These criteria included: adequate space, adequate available funds, adequate staff and satisfactory working conditions, adequate organization, cooperative planning, problem centered approach, and continuing evaluation.

The first phase of the investigation of the practices in the state supported institutions in South Dakota was that of visiting the institutions and interviewing the appropriate authorities. The second phase was that of securing the opinions of the school personnel for whom the program was established through the use of the questionnaire method.

The Results of the Study

The following statements summarize the findings of this study:

1. All of the state-supported institutions of higher learning in South Dakota reported that adequate physical facilities for in-service education activities are generally available with the exception that classrooms are occasionally too small in some of the institutions.
2. Most of the institutions studied stated that the availability and accessibility of library materials for use in in-service education programs constituted an acute limitation to the total program.
3. Authorities stated that their finances are, for the most part, adequate for the present program, but if the program is to expand and include activities which are not self-supporting, additional funds are needed.
4. The administrative organization of the in-service programs has been established to fit the present program and does not actively foster growth and extension of the program.
5. The members of the college faculty share in the planning of the program, but little effort is made to involve other professional or lay groups.

6. The topics and problems considered in the programs of in-service education are problems common to school personnel and school districts generally. Little effort is made to emphasize the specific individual and group problems of the participants and the school systems served by the colleges.
7. The state supported institutions of higher learning in South Dakota emphasize extension classes, correspondence courses, and workshops in their approach to in-service education. Internships, clinics, consultative services, and study councils are emphasized to a lesser extent. Workshops conducted on campus are recognized as a part of the teaching load. The other services generally are given little recognition in the assignment of teaching loads.
8. An evaluation of the program of in-service offerings is not a regular activity at most of the institutions. When an evaluation is undertaken, the college faculty rarely consults the participants or other professional or lay groups.
9. It was reported that participation is prompted, for the most part, by a desire for salary increments or requirements for renewal of certificates. The principal obstacles to participation are lack of time and inconvenience of travel.
10. The questionnaire returns indicate that extension classes and correspondence courses are more readily available than other in-service activities and are more frequently participated in than any other type of college sponsored in-service activity in South Dakota. 253 pages. \$3.30. Mic 56-2569

EDUCATION, THEORY AND PRACTICE

SOME FACTORS AFFECTING THE OCCUPATIONAL CHOICES OF SIXTH AND EIGHTH GRADE RURAL BOYS

(Publication No. 18,315)

Norton Russell Bagley, Ph.D.
The University of Connecticut, 1956

Statement of the Problem

Factors of interest, capacity, reality, key persons and values of sixth and eighth grade rural boys were investigated to discover effectiveness of developmental theories of occupational choice, to find factors on which choices are based, to obtain information about maturity levels and to investigate sixth and eighth grade, socio-economic class, and farm and non-farm group differences.

Procedure

A lead-primer interview was outlined after a review of the literature on occupational choice, interests, maturity levels and rural-urban population differences.

Interviews were given to fifty boys in grade six; ages ten-eleven; average I. Q. range; from unbroken homes; twenty-five New Hampshire rural farm; twenty-five New

Hampshire rural non-farm. Fifty boys from grade eight; ages thirteen-fourteen; other criteria and groups as for grade six. Groups were classified as to socio-economic status using father's occupation as a criterion.

Interviews were tape-recorded, and transcripts made from which categorized statements were evaluated for use in testing factors. Charts were set up for each factor sampled, and Chi Square computed, and tests of significance of differences for each factor between sixth and eighth grades, between farm and non-farm, and between upper and lower socio-economic groups were made.

Results

Interests--A range of forty-four occupational interests was found with eleven having no choice.

Ninety of the hundred express an interest reason for choice and indicate a recent time for choice.

All groups prefer sports as out-of-school interests with baseball, basketball and football ranking highest. Westerns, mystery and comedy lead as likes in motion pictures, radio, television and books. Eighth grade boys read more than sixth grade. More than half the sample likes to dance.

More of the sample are aware that interests change than are unaware.

Reality and capacity factors--The group showed little information about college, high school curricula, or awareness of the differences between high school and grade school. The boys are not aware of the influence of realistic factors as funds for college, effect of army draft, or of school grades on educational plans. The sample showed little self-appraisal of capacity. Most of the group intend to marry, but are unaware of the realistic factors involved.

Values--The group sees success in terms of "getting somewhere" and does not feel money to be of great importance. Being socially liked is preferred to other work rewards.

Conclusions

The results bear out the theory of occupational choice advanced by Ginzberg and associates.

Both sixth and eighth grade boys make occupational choices based upon interests. There is a trend toward greater self-appraisal of capacity and evaluation of reality on the part of the eighth graders.

The lower socio-economic group is more realistic on time perspective and money factors than is the upper socio-economic group.

Few significant differences were found between farm and non-farm groups with trends toward the farm group's being more realistic about appraising financial and capacity aspects than the non-farm. The farm group is slightly more influenced by the father's occupation than is the non-farm.

No group seems greatly influenced by parental or peer approval of occupational choices.

242 pages. \$3.15. Mic 56-2570

APPLICATION OF A THEORY OF COMMUNICATION
TO PROBLEMS OF SUPERVISION OF PRIMARY
EXTENSION SCHOOLS OF THAILAND

(Publication No. 17,542)

Sai Bharnuratna, Ed.D.
The University of Florida, 1956

In 1951, a new type of school named the primary extension school was created by the Ministry of Education of Thailand. The purpose of the school is to extend the education of those children -- 80 percent of the total -- who having completed the compulsory primary (prathom) schools do not enter the first level of secondary (matayom) schools. The main reason for their failure to enter the matayom schools is that the program, basically academic, is unsuited to their level of achievement, development, and vocational aspirations. The program of the primary extension school emphasizes health, citizenship, pre-vocational training, home and family living, and improvement of community life.

It is anticipated that when several primary extension schools have been established in every amphur (county) of the kingdom and have begun to function as expected, compulsory education will be extended to seven years. It is thought also that the schools may develop the pattern and lay the foundation for the future comprehensive high school.

A division to supervise the development of primary extension schools has been created in the Ministry of Education. As Chief of the Supervisory Staff, the writer was sent to the United States in 1954 to study ways of developing supervision of the schools so that the desired goals would be attained. This dissertation is the culmination of his study.

The major assumption underlying the study is that communication is central to problems of supervision and that by applying operating principles derived from research supporting the theory of communication advanced in the study, supervisors may lend greater assistance in solving the problems of the schools. The three phases of the study are (a) determining the problems, (b) delineating a theory of communication and supporting it by research, and (c) applying operational principles implied by the theory to problems of supervision.

The method used in the study is mainly analysis and synthesis. The history of Thailand, the land, the peoples, and the culture, the development of public education, the development and status of primary extension schools are surveyed both for the purpose of analyzing and locating problems and for presenting the Western reader with background for interpretation. A questionnaire was sent to leaders having direct responsibility in some way for developing primary extension schools with the request that they state the three problems (with suggested solutions) of the schools which they considered most important. Levels of responsibility represented were the Ministry of Education, the Technical Assistance Mission of Foreign Operations Administration, Area Commissioners, Changvad and Amphur Inspectors, and principals.

Problems selected through the foregoing methods include adequate leadership at each level of responsibility, communication within and between governmental agencies, teachers adequate for expected roles, a functional curriculum, initiative at the local level, buildings and equipment adequate for the desired program.

The theory of communication presented and supported by research involves four major elements: source, message, destination, and "feedback." Pure or exact, communication (rarely occurring) is conceptualized as identity of perception of the same message by the source (communicator) and destination (receiver). Treated specifically in relation to communication are the self, the nature of perception, the nature of the source, varying aspects of the message, the nature of the receiver, and the significance of the "feedback."

Operational principles derived from research and implied by the theory are applied to problems of supervision in two ways: (a) by analyzing case situations in which the principles have been used, though perhaps not consciously so, by leaders in pilot projects in Chachoengsao and Krung Thep and (b) by analyzing hypothetical situations and applying the operational principles to them.

241 pages. \$3.15. Mic 56-2571

AN ANALYSIS OF THE TRANSITION FROM
HIGH SCHOOL TO COLLEGE IN
ENGLISH COMPOSITION IN SELECTED
NEW YORK STATE SCHOOLS

(Publication No. 18,320)

James Ely Cochrane, Ph.D.
The University of Connecticut, 1956

STATEMENT OF THE PROBLEM

Five hypotheses were established to find answers to the question: what identifiable influences in the high school program of adjudged good writers seem to contribute materially to their status in a given college? The hypotheses were that good writers would come from high school programs where there existed more individualization of instruction, provision of sufficient writing, provision of similar course emphasis, provision for use of students' interests (including an interest in writing) and stimulation of the habit of wide reading.

METHODS USED

Seven instructors of freshman composition at the State University College for Teachers, Albany, New York, submitted the names of their best and poorest writers in the graduating class of 1957. From this group, fifty good writers and forty poor ones responded to a detailed questionnaire about their high school programs. They named high school teachers who had helped them with their English written composition in high school.

Responding to a questionnaire sponsored by the Regents Articulation Committee, seventy high school teachers throughout New York State described their practices in the teaching of English written composition.

Analysis of the data, which also included interviews with the seven college instructors and relevant material in the files of the Student Personnel Office followed two patterns (1) contrast and comparison of the three bodies of opinion involved, (2) tests for significance of the differences between the good and poor writers.

RESULTS OF THE STUDY

The results corroborate previous research, furnish further justification of the hypotheses of the study, and provide grounds for recommending changes in the high school programs and suggestions for further research. The following seem to be the most important findings:

1. The good writer in a given college is usually a significantly better reader as measured by a standardized test; he scores significantly higher on the average on the language section of an intelligence test.
2. Good writers received significantly more insistence upon revision and rewriting of their compositions in high school.
3. College and high school teachers and their students heartily endorse the principle of more individualization of instruction.
4. In general the high schools in the study sought rather unsuccessfully to stimulate wide reading by assigning a set number of book reports for the year.
5. Successful articulation between the high school and the college in the study is largely a matter of chance because there was a difference in purposes between the high school and college teachers, there was a difference in course emphasis, there was little actual interdependence and practically no comparable success for poor writers in high school and college composition.

RECOMMENDATIONS

1. Reduce staff loads in English in high school and in college, especially in high school.
2. Teach reading skills directly in high school and as needed in college; stimulate wide reading for pleasure by more effective means than a book-report program.
3. Have students write more compositions and revise carefully what they write.
4. Concentrate upon organization and mechanics in the writing of expository prose.
5. Strengthen interdependence between high school and college English teachers by establishing better channels of communication.
6. Set up case studies of the background of a group of good readers who are adjudged poor writers in college.
7. More colleges study their own articulation problems in English and collate the results of the findings of such studies. High schools also study their articulation problems with the colleges to which the majority of their graduates go.

275 pages. \$3.55. Mic 56-2572

AN ANALYSIS OF THE NATURE AND STATUS OF ACTION RESEARCH IN EDUCATION

(Publication No. 17,125)

Virginia Grace Goldsmith, Ed.D.
University of Washington, 1956

Supervisor: Dr. Edgar Draper

Action research in the area of curriculum improvement is a technique or method for improving the learning experiences of pupils, instructional materials, and teaching procedures through the application of the scientific method. Increased attention has been directed toward the use of action research in education during the past decade, and both administrators and teachers have advocated the application of research findings to the improvement of educational practices.

In their efforts to employ research designs, many educators made investigations which did not qualify either as action research or traditional research. On the other hand, action-research studies were developed which appeared to compare favorably with the design of traditional research.

The author attempted, in this thesis, to determine the status of action research through analysis of the literature and investigation of research studies in the field of education. It seemed appropriate, therefore, that a critical analytical study be made of action research in education to present findings which might be helpful to administrators and teachers who are interested in initiating action-research projects.

The specific purposes for this study were to clarify the meaning of action research and to present the nature and status of action research based on the analysis and evaluation of investigations purported to be in that area. Information obtained from the literature, interviews, and correspondence was used as a basis for (1) presenting studies of action research; (2) analyzing group activities and techniques utilized in formulating and planning action-research studies; (3) analyzing research techniques and data-gathering and appraisal devices used in action research; and (4) making some comparisons between action-research and traditional-research studies.

The findings of the study were:

1. The status of action research is not too well established. A few investigations seemed to have been conducted as scientifically as possible under practical conditions, but the majority of studies conducted in this field are not worthy of being called research.

Some of the differences between fundamental and action research are largely semantic. The terminology of action research has not been too well clarified, and more careful studies should be made of appropriate designs so there will be less confusion in the development of action research.

2. The consultant who has curriculum and research training is vital to the action-research program since much needs to be done to improve techniques of investigation and to train teachers in the use of tools of research.

3. There seems to be value in the study of group processes. Through group discussion, group participation, and the study of group development, action researchers learned steps in problem solving as well as an awareness and interpretation of their own "feelings" and "feelings" of the group which seemed to lead to increased productivity.

4. Action research is considered an effective means of improving teachers and learning and, thus, changing the

curriculum. Many participants reported that, as a result of the projects, they were willing to make changes or refuse to make changes on the basis of the results of the investigations in which they participated.

5. Some action researchers are experimenting in fields relatively untouched by educational research. These researchers are adapting fundamental research tools or developing new instruments to use in firsthand contacts with children and in studying real problems of the school which are identified by teachers and administrators as important.

6. The editorial policy of educational publications has not been rigorously enforced in upholding standards of quality in the publication of action-research studies. Only a small percentage of reported studies can be classified as either research or action research.

215 pages. \$2.80. Mic 56-2573

A STUDY OF COLLEGE ADMISSION COUNSELING IN MICHIGAN

(Publication No. 17,156)

Robert J. Hanson, Ed.D.
Wayne University, 1956

Purpose

The purpose of this study is to investigate the extent and type of advisory services available to students seeking admission to institutions of higher education in Michigan. Specifically the study seeks to determine:

1. The kind of counseling services provided by college admissions people in Michigan.
2. The relationship between admissions policy and extent and type of counseling provided.
3. The status of admissions counseling in Michigan compared to similar services in institutions throughout the United States.
4. Changes in the demand for admissions counseling and the reasons for such change.

For the purposes of this investigation, admissions counseling is interpreted to include the pre-registration advisory services available to the college or university applicant. Counseling services of a therapeutic nature are not included in this study.

Procedure

The study is mainly descriptive. Three major areas are explored through the means of a questionnaire sent to the chief admissions officers of forty-four Michigan institutions. This number includes all accredited institutions of higher education in Michigan in 1954 except for the theological seminaries. In addition to information from the questionnaire, additional data were obtained by personal interviews with admissions officials of twenty-five of the above institutions.

The three main aspects investigated are:

1. The organizational structure of the admissions office, its relationship to other parts of the institution, the number of personnel available, and the preparation and training of the admissions personnel.
2. The procedure followed in the admission of various types of applicants, the factors considered most impor-

tant in making admissions decisions, the problems of admissions officials, and suggested solutions.

3. The relationship of Michigan secondary schools to the institutions of higher learning, the methods now used to communicate between the two levels, and the areas of mutual concern.

To provide background data for a study of college admissions work, a preliminary chapter of the study traces the historical development of admissions policies in the United States from colonial times to the present.

For purposes of comparison, the results of a general survey of admissions counseling in the United States is presented. The data for this part of the study were obtained from the results of a questionnaire circulated by the American Association of Collegiate Registrars and Admissions Officers to its membership in 1954. The material is used with permission of the Association as an integral part of the survey of admissions counseling in Michigan.

Conclusions

1. Although college admissions policies have become more flexible in recent years this does not seem to have been a major reason for the increase in admissions counseling provided by Michigan institutions of higher learning. According to admissions officials, admissions counseling services have expanded in Michigan in recent years mainly because of increased enrollments and the earlier stimulus of the veterans' enrollment.
2. Twenty-eight per cent of the colleges and universities in the United States have full-time trained admissions counselors whereas in Michigan twenty-seven per cent of the institutions have full-time trained personnel to counsel with applicants.
3. There seems to be no relationship between size of Michigan institutions and the organization of admissions processes.
4. The major problem confronting admissions personnel in Michigan is lack of time and staff to do a satisfactory job.
5. Fifty-four per cent of the college admissions officers in Michigan believe there is a need for more coordination between themselves and the secondary school guidance workers.
6. In the opinion of sixty per cent of the admissions officials in Michigan, the high school student is adequately counseled in regard to college entrance requirements. However, only thirty per cent of the admissions people consider that their applicants have gained a realistic appraisal of their abilities while in high school.
7. The main suggestion made by admissions officials for improving the high school counseling of college-bound students is "to develop a larger group of informed and interested high school guidance people."

204 pages. \$2.65. Mic 56-2574

**A STUDY OF SOME ASPECTS OF TEACHING
AND LEARNING IN A COLLEGE CASE-METHOD
COURSE IN HUMAN RELATIONS IN BUSINESS**

(Publication No. 17,127)

John William Hennessey, Jr., D.B.A.
University of Washington, 1956

This work is a result of the phenomenal growth of interest in the human factor in industry and the vast proliferation of training programs and academic courses in this area. It is addressed to the need for further understanding of the teaching-learning process in human relations training, with its unique problems and high potential for increasing personal effectiveness.

Specifically, this study tests hypotheses concerning the relationship among certain variables in a case method human relations course taught in a college of business administration. The major variables considered are: (1) students' initial motivation in taking this course, (2) their morale while doing so, (3) students' perceptions of their instructor's human relations mindedness, and (4) students' learning (especially attitudinal learning) or teaching effectiveness.

Methods for measuring these variables are presented and discussed in detail. They include questionnaires, surveys using Likert-scale responses, and reactions to cases and films on human relations. The study population consists of 230 students and four instructors all involved in a specific human relations course in Spring 1954. There were five daytime sections and one evening section of this course.

Statistical analysis of the data gathered during the study includes t-tests of the significance of the differences among the sections regarding relevant population characteristics and variable performance data. It also involves the computation of coefficients of correlation among the variables.

From the statistical processes it is clear that one section ranks significantly higher and one significantly lower than all the others as measured by morale, students' perception of their instructor's human relations mindedness, and indices of attitudinal learning. A close examination of these results and an intensive study of the singular findings regarding the lowest section led to further insights. The principal of these is the establishment of the chain of expectations among variables: students' perception of their instructor's human relations mindedness → morale → learning. Empirical observations and caveats for human relations training develop and apply these ideas further.

Some of the major conclusions of this study are:

1. The student's initial motivation in this kind of human relations training is not an influential factor toward determining his morale or success in the course experience.
2. The students' perception of their instructor's human relations mindedness (HRM) is a useful index toward understanding students' morale and certain aspects of their successful learning. Especially the learning of effective human relations attitudes seems dependent upon this perception of HRM.
3. Morale fluctuates broadly and this apparently contributes to learning. The mean morale score is higher in sections which perceive their instructor as having higher HRM and wherein attitudinal learning is greater.

4. Students appear to be able to learn certain knowledge and skills independent of their morale or perception of their instructor's HRM. This is not true of the learning of attitudes.

In a final section some questions are posed for future research. 238 pages. \$3.10. Mic 56-2575

**FACTORS WHICH HAVE INFLUENCED THE
DEVELOPMENT AND SUCCESS OF TWO
SELECTED RURAL COMMUNITY SCHOOLS**

(Publication No. 17,555)

Lessie Lee Murray, Ed.D.
The University of Florida, 1956

This study was concerned with the definition of a community school and with the identification of characteristics and practices associated with the development and success of two selected rural community schools.

Procedures

The selection of two rural community schools used in this study were made from recommendations of the forty-eight state school superintendents and their supervisory staffs, a national jury of sixty-one community-school experts, and the Committee on Rural Life and Education of the National Education Association.

From related research three definitions and sixteen characteristics were formulated by the writer. These definitions and characteristics were submitted to a jury of experts for validation. These jurors were asked to accept, reject, change or suggest new definitions and characteristics. Further, they were asked to cite specific practices desirable in a community school and which exemplified each of the characteristics.

The definition and fifteen of the sixteen characteristics were validated. The jurors submitted a list of one hundred and twenty-five practices. In summarizing the findings and presenting the composite thinking of community-school experts, the writer submits the following definition of a community school:

The community school is one which recognizes available physical and human resources in order that they be used in improving all aspects of living and learning for the entire community. Needs, interests, and problems of the individual, the school, and the community are its chief concern. It is noted for its democratic leadership, its cooperative spirit, and its interest in the maximum development of the individuals whom it serves.

The definition was further validated when the following characteristics were found to be present in the two rural community schools used in this study:

1. The community school assumes its share of responsibility in identifying community needs.
2. The community school assumes its share of responsibility in meeting community needs.
3. The community school assists in providing a program of community recreation.
4. The community school attempts to prepare persons at any age level to take their places as responsible contributing members of the community.

5. The community school strives constantly to elevate standards of living in the community.

6. The administration of the community school is democratic, involving teacher-pupil-lay citizen participation.

7. The staff and personnel of the community school are selected with school-community objectives in mind.

8. The community school provides for a continuous evaluation of its program.

9. The community school encourages student and faculty participation in community activities.

10. The community school strives to provide a program of activities which enrich both classroom and community experiences.

11. The community school's calendar of activities is planned cooperatively with the community's calendar.

12. The community school includes selective and worthwhile educational activities which are financially self-supporting.

13. The community school helps to provide and to develop leadership in the community.

14. The community school uses both human and natural resources of the community for the best type of living and learning.

15. The community school assists in providing educational activities needed by the adults.

Implications

1. With the community school defined and its characteristics and practices identified, educators and laymen have a frame of reference for developing programs for the best learning and living in schools and communities.

2. This study should give educators a better perception of the values of the community-school concept in education--how community schools are begun, the factors which move them forward, and a description of outstanding practices which give them community emphasis.

3. This study should assist teacher-training institutions in planning programs of study for prospective rural community-school personnel.

326 pages. \$4.20. Mic 56-2576

A STUDY OF TEACHERS' USE OF BUSINESS-SPONSORED INSTRUCTIONAL MATERIALS IN SELECTED ELEMENTARY SCHOOLS

(Publication No. 17,166)

Helene Freud Siegel, Ed.D.
Wayne University, 1956

A desire to enrich classroom experience through planned use of a variety of types of instructional material has motivated teachers to search for and draw upon a wide range of sources supplying supplementary materials. These materials include those known as "sponsored materials."

This study concerns itself with a consideration of such materials which are distributed to schools free or with a nominal fee to cover shipping charges.

While large quantities of business-sponsored materials are used by teachers, business efforts to improve such ma-

terials are hampered by a need for more information concerning the nature of their utilization. In view of this fact the central purpose of this study was to determine the judgments of a designated group of elementary classroom teachers (users of business-sponsored materials) as to how the educational usefulness of such materials could be improved. Judgments were sought on questions involving: (a) announcements of the availability of business-sponsored materials, (b) features and types of business-sponsored materials, (c) teachers as advisers to business-sponsors of materials.

A preliminary investigation was undertaken to locate a source or sources for securing names and addresses of teachers known to have ordered sponsored materials. It was found that the Dairy Council of Detroit maintained records of names of all classroom teachers who ordered their materials. Information gathered from this sponsor's files, along with educator and sponsor pilot interviews, provided the material necessary for the preparation and distribution of a questionnaire to 796 elementary school teachers in the City of Detroit and in 26 neighboring communities.

While 46 per cent, or 366 teachers, returned the questionnaire, the study design provided for a random sample of the 430 teachers who did not respond. This intensive follow-up was made to determine whether the replies of non-respondents differed systematically from those received from the 366 respondents.

Results of the study indicate that elementary, city public school teachers, users of business-sponsored materials, find these materials generally useful. While teachers generally accept such materials, they indicate that improved materials could be produced and that such improvement would extend their classroom utilization.

To move in this direction, teachers indicate a need for better programs announcing the availability of sponsored materials. Unless teachers are made aware of the availability of materials, they cannot order them. Findings also indicate that availability information must include facts relating material to grade level and curriculum area. Neglect of these considerations will reduce utilization of sponsored materials.

Study response indicates that teachers are looking for good supplementary materials for use in the units they are teaching. The teachers' primary interest is in those materials which stimulate the interest of their students through its display, resource, or informational use.

Teachers also indicate that they are willing to give sponsors consultative advice in their efforts to produce better materials for school use. The acceptance of such advice, they indicate, would assure improved materials inviting extended classroom utilization.

118 pages. \$1.50. Mic 56-2577

KARL MANNHEIM'S SOCIAL THEORY AND CONCEPT OF EDUCATION

(Publication No. 18,214)

Joyce Fye Wylie, Ph.D.
University of Illinois, 1956

This dissertation examines the work of Karl Mannheim with particular reference to his social theory and concept of education.

Initially, it explores the personal experiences and "currents of thought" influential in the formulation of the theory, and surveys, historically, the development of Mannheim's work, through his philosophically, psychologically and sociologically orientated interests, toward the idea of planning for freedom and the role of education in that circumstance.

A propos of his social theory itself, its basic elements are discussed in their static and dynamic aspects. The significance of his characterization of modern Western society as transitional--moving from the stage of invention to the stage of regulation in organizational pattern and in concomitant modes of thought--is noted. The organizational framework of society, based upon groups, is described, and the function of what he discerns as a group of special significance--the intellectual elite--is considered.

An analysis of Mannheim's view of social change locates the causal factor of change and gives instances of the areas in which such change is giving rise to major problems of adjustment, particularly in respect to movement from laissez-faire to regulated organization, from democracy of the few to mass democracy, and in changing social techniques. Reasons for our failure to adjust adequately to these changes are posited as the lag of moral and social development behind that of extremely rapid technical development and the increasing tendency toward functional rather than substantial rationalization in to-day's industrialized society. The consequence of our failure to adjust is a crisis situation, the discernable symptoms of which are enumerated and the nature of which is designated as a choice between totalitarian or democratic planning.

Rejecting the totalitarian solution to the problem of planning, Mannheim suggests the Third Way as a viable means of preserving democratic freedom in the stage of societal regulation. This involves an examination of his concept of power, of the meaning of planning for freedom and of suggested institutional reforms which might possibly be undertaken.

But since society is comprised of human beings, the major task in achieving freedom in a planned democracy is that of the transformation of man--modern democracies must seek to produce a desired citizen-type. This is the task, very largely, of education, which Mannheim perceives as a potent social technique.

Education, for him, is more than formal schooling; social living itself exerts a significant educative influence through the direct and indirect pressures emanating from various groups. Increased application of the knowledge of this fact of education is encouraged by our growing knowledge of the impact of the social sciences, as revealed through investigations. As to formal schooling it is viewed from a broad, sociological standpoint persistently concerned with the widening, lengthening and integrating of deliberate educational endeavour.

The aims of education must be socially relevant, the school must be progressive in the sense that it co-operates with other educative agencies, and the curriculum needs must be centered on a social core. The intellectual elite, from key positions, are charged with the mission of effecting a genuine democratization of education.

The theory is assessed in terms of the basic philosophy underlying it and a concluding summary is given.

203 pages. \$2.65. Mic 56-2578

ENGINEERING

ENGINEERING, GENERAL

THE APPLICATION OF MATHEMATICAL TECHNIQUES IN THE FIELD OF INDUSTRIAL ENGINEERING

(Publication No. 17,467)

Richard Albert Dudek, Ph.D.
State University of Iowa, 1956

Chairman: Professor J. Wayne Deegan

This dissertation advances the thesis that many precise analytical tools from statistics and advanced mathematics are available which are applicable and are being applied to various kinds of Industrial Engineering problems and which could be utilized to advantage by more industrial engineers.

To support this thesis and show that these tools could improve industrial engineering investigations and decision-making processes, the general procedure for the investigation involved:

enumerating as many actual applications of statistics and mathematics to industrial engineering problems as feasible,

showing in some detail use of a few selected techniques representing both areas, and

holding personal conferences with individuals, industrialists, consultants, educators for the purpose of
(a) clarifying questions arising from their answers to an original questionnaire submitted to them, and
(b) determining their opinions and/or attitudes with respect to the industrial engineers' need for making use of the analytical tools available in advanced mathematics.

Conclusions from the investigation may be indicated in terms of three major categories.

(1) General Application of Mathematical Tools.

(a) Mathematical techniques have been used to aid problem solving in various realms of management control, e.g.: General Management, Engineering and Design, Manufacturing, Sales, Controlling, and Research. (b) While industrial engineering methods are still largely devoted to problems of manufacturing, indications are that their applications in solving general management problems is increasing. (c) Individuals associated with industrial engineering either professionally or academically agree that it would be of value for Industrial Engineers to have an appreciation of contributions that statistical procedures provide in various problem areas. (d) In many instances statistical and mathematical techniques provide: more convenient, economical, and precise methods for solving certain kinds of problems and make it possible to specify criteria in terms of which these solutions can be evaluated, and render problem solutions not obtainable by other known method. (e) A broader knowledge of general statistics by industrial engineers should increase their understanding of and appreciation for more conventional pro-

cedures like Statistical Quality Control and Work Sampling. (f) A need for ways of disseminating new information concerning appropriate techniques was indicated since many applications revealed in this study had no general distribution. (g) Industry manifests vital interest in promoting further use of mathematical tools to problems of industrial engineering by encouraging training or training individuals themselves. (h) Statistics appears to be the area providing most techniques adaptable for use in solving industrial engineering problems. However, other areas, like Matrix Algebra, Boolean Algebra, are potentially important sources for techniques in specialized problem areas.

(2) Industrial Engineering Curricula. (a) The majority of Industrial Engineering curricula do not provide adequate coverage of mathematical methods when considering needs indicated by the consensus of industry in this sample. These opinions indicated that as a minimal requirement (with courses identified in terms of current course nomenclature, given in semester hours), curricula should include:

For Bachelor of Science:

- 3 - Statistical Quality Control
- 6 - Statistical Theory
- 3 - Mathematical Survey or "Appreciation"

For Master of Science:

- 3 - Matrix Algebra
 - 3 - Boolean Algebra or Symbolic Logic
- These courses might be optional.

For Doctor of Philosophy:

Additional courses optional to student.

(b) As to course content, consensus was that it should provide a sound theoretical foundation in basic concepts with appropriate emphasis on applications so that a working knowledge is achieved.

(3) Organizational Structure for an Industrial Engineering Department in Industrial Installations. Industry is interested in having available within the organization individuals who are competent in mathematics. A most desirable Industrial Engineering Department organizational structure would include several industrial engineers with advanced mathematical training and one or more mathematicians on a staff basis.

217 pages. \$2.85. Mic 56-2579

ENGINEERING, AERONAUTICAL

**ON SUPERPOSABILITY AND
SELF-SUPERPOSABILITY CONDITIONS
FOR HYDRODYNAMIC EQUATIONS
BASED ON CONTINUUM**

(Publication No. 18,139)

Richard Robert Gold, Ph.D.
University of Illinois, 1956

Due to the nonlinearity of the equations of motion in the theory of fluid dynamics it is frequently necessary to assume that certain terms, usually the nonlinear terms, are small compared with those retained, such that the solution is valid, for example, only when the motion is slow. Perhaps equally as often it is tacitly assumed that two or more distinct motions are linearly superposable and in certain cases both assumptions are made. Examples of these approaches are the analyses of Stokes and Oseen and the theory of boundary layer and wakes behind solid obstacles which make use of the first assumption and various analyses of Rankine and Lamb, to name a few, who make use of the superposability criterion.

The purpose of this investigation is to examine the basic concepts of superposability and self-superposability of nonlinear partial differential equations, in particular those equations of interest in hydrodynamics.

After reviewing the literature on the subject, the fundamental constructional philosophy of superposability was discussed in Chapter 3. In the subsequent chapters, superposability and self-superposability conditions were established for the viscous equations of motion both for incompressible and compressible flows and under the assumptions of a Newtonian and Non-Newtonian gas. In addition, these conditions were determined for the equation of motion of a hydro-magnetic fluid and the potential equation of gas dynamics.

A direct application of the superposability condition for any given nonlinear partial differential equation is in the construction of useful superposable motions. This is discussed quite briefly in the text and its possibilities suggested especially with regard to the work done by previous authors. In particular, however, this paper is concerned with the more general application of utilizing the self-superposability condition to associate with the nonlinear partial differential equation in question a system which can be solved in general in a rigorous manner. Subsequent to determining the self-superposability conditions for the previously mentioned hydrodynamic equations a thorough analysis is made of the solution of this associated system.

In connection with the principal application referred to in the preceding paragraph it was necessary to review the literature on the subjects of boundary value problems and overspecified systems, i.e., systems of partial differential equations containing more equations than unknowns. The results of these literature surveys were then applied to the problem at hand introduced by the aforementioned application.

Frequently in the analyses of this paper only the surface of the problem is treated and frequently mathematical detail vital to any thorough treatment of a problem is only pointed out rather than being fully explored. The reason for this fact is that this paper is meant to be only a pre-

liminary cursory treatment of the subject designed to establish the fundamental facts. It is hoped that this work will suggest many additional applications and analyses treating the detail omitted out of necessity.

147 pages. \$1.95. Mic 56-2580

**ON MULTIPLICITY THEOREMS AND AN
EXACT SOLUTION IN DIABATIC FLOW**

(Publication No. 18,143)

Winthrop Adolph Gustafson, Ph.D.
University of Illinois, 1956

The theory of diabatic flow is based upon the usual assumptions of gas dynamics, i.e. the medium is inviscid, non heat conducting, and obeys the laws of a perfect gas. The heat distribution function is assumed to be given as a continuous function of the independent variables, which implies that the heat is introduced by a continuous distribution of heat sources or sinks in the flow field.

The concept of multiplicity of flows having the same streamline pattern is developed, in this work, for diabatic flows, which yields a Substitution Principle and the associated canonical equations in direct analogy to isentropic results. The concept of multiplicity is then broadened somewhat by constructing two other Substitution Principles which relate diabatic flows having similar streamline patterns, but which correspond to the same system of canonical equations as derived for the Substitution Principle for identical streamline patterns.

A one-parameter family of exact solutions of the diabatic flow equations is presented in terms of the usual variables instead of the canonical formulation. It is shown that all members of this family of diabatic flows behave according to a polytropic law, each member of the family being associated with a different polytropic exponent, and one member is the isentropic case.

Finally, the canonical system of equations is investigated for the purpose of obtaining the same family of flows as presented previously. Considering the polytropic nature of the flows and the form of the external heat distribution function, it is possible to reduce the problem to a form which is discussed in the literature in connection with isentropic flow. It is thus demonstrated that this particular family of flows can be obtained by solving the diabatic flow equations either in their usual form, or in canonical form.

86 pages. \$1.50. Mic 56-2581

**AN AERODYNAMIC THEORY OF A
SUPERSONIC PROPELLER**

(Publication No. 18,279)

Donald Earl Ordway, Ph.D.
Cornell University, 1956

A supersonic propeller with a finite number of thin blades is studied. The forward speed is subsonic but the relative speed at each blade is supersonic. The blades are assumed to be lightly-loaded and attached to an infinite cylinder as a hub.

The method of approach is to distribute appropriate singularities over a blade reference surface in a fashion analogous to supersonic thin-wing theory. Accordingly, Prandtl's idea of distributing "consecutively-working" fixed sources is adopted to derive the potential for a source of time-dependent strength traveling along an arbitrary path through a compressible medium otherwise at rest. The usual assumptions of small-perturbation theory are made. Similarly a doublet having also time-dependent orientation is considered.

Then, in particular, the potential for a constant-strength source having uniform supersonic speed but subsonic forward speed along a helical path is found. Transforming to a moving coordinate system with the source at the origin and one axis tangential to the path, this potential is approximated in the neighborhood of the source. The approximation gives a "Modified" Rear Mach Cone which swirls in toward the axis of rotation as it expands rearward along the helical path. A numerical example shows good agreement between the exact and approximate intersection of the cone with the plane tangent to the local helical surface.

Further investigation of the exact potential in cylindrical coordinates reveals the "opening-up" of the "cone" due to the subsonic forward speed. Also the Mach Lines created by the intersection of the propeller plane with the Mach Surface from a source anywhere along a mean blade radius reduce to a pattern composed of various portions of a single infinite spiral. Hence the results can be expressed in terms of a "characteristics diagram" similar to that of Prandtl-Meyer flow. They have the same form as those given by Lamb and Taylor for zero forward speed.

The approximate "modified" sources are distributed over a blade reference surface. By first examining a distribution of ordinary supersonic sources in a plane, the usual relation between the vertical perturbation velocity and the distribution strength is found consistent to the order of terms neglected in the approximation to the potential. The differentiation and limit processes are performed directly without recourse to Green's Theorem.

Finally the theory is applied to determine the pressure distribution over a blade having either thickness or camber. The latter is possible since, within the approximation, the upper and lower surfaces are non-communicating except for a region near the tip. Of course, there is also a hub interference region. Neither of these regions is treated, though approaches are indicated. For no induced velocities, a twisted-flat-plate blade with an angle of attack inversely proportional to the total relative Mach number at each section is solved. At the leading edge the pressure is simply the Ackeret value and an example shows that it remains essentially the same over the first half. However, it does rise with further increase in distance from the leading edge, reaching a value about 20% above the leading-edge pressure, at the trailing edge. Also a limiting case of blade interference is roughly computed.

178 pages. \$2.35. Mic 56-2582

ENGINEERING, CHEMICAL

OXIDATION OF SULFUR DIOXIDE
IN FOG DROPLETS

(Publication No. 18,124)

Donald Ray Coughanowr, Ph.D.
University of Illinois, 1956

A study was made of the simultaneous absorption and oxidation of sulfur dioxide from dilute humidified air mixtures by quiescent water droplets containing manganous sulfate. The object of the work was to obtain information on the rate of conversion of sulfur dioxide to sulfuric acid in a natural fog in an industrial atmosphere. Manganese sulfate was used because it is an active catalyst for the oxidation of sulfur dioxide and may be present as a nucleating agent in natural fog droplets.

In order to interpret the data for the absorption of sulfur dioxide by droplets, the kinetics of the reaction of sulfur dioxide and oxygen in dilute solutions of manganous sulfate was studied at 25°C. The concentration of manganous sulfate was varied from 4 to 14 p.p.m. The reaction follows a zero order mechanism with respect to both sulfur dioxide and oxygen, and the rate is proportional to the square of the concentration of manganous sulfate. The rate of the reaction is decreased by the presence of a small amount of sulfuric acid, but the mechanism remains zero order; with increasing concentration of acid, the reaction rate decreases rapidly and becomes constant at higher concentrations of acid.

A mathematical analysis was made of the steady state absorption of a gas by droplets in which chemical reaction occurs; both zero order processes and first order processes were considered. The resulting equations were used to interpret the data.

In the study of the rate of absorption of sulfur dioxide by droplets, the concentration of sulfur dioxide was varied from 20 to 300 p.p.m., the concentration of manganous sulfate from 250 to 1000 p.p.m., and the droplet diameter from 700 to 900 microns. The rate of absorption is a function of the concentration of sulfur dioxide in the gas and the concentration of manganous sulfate in the droplet. The initial rate of absorption is controlled by the resistance of diffusion in the liquid and is less than ten percent of the rate of absorption by droplets containing excess hydrogen peroxide, for which case the resistance of diffusion in the gas controls. For droplets containing 250 p.p.m. manganous sulfate, the rate of absorption follows a zero order mechanism.

The data for the absorption of sulfur dioxide by droplets containing 250 p.p.m. manganous sulfate were used to estimate the rate of conversion of sulfur dioxide to sulfuric acid in a natural fog. This is based on the following approximations: (1) concentration of sulfur dioxide in the air, 1.0 p.p.m., (2) diameter of fog droplets, 20 microns, and number concentration of droplets, 48 per cc., and (3) each fog droplet was nucleated by a single particle of MnSO_4 (or MnO which is converted to MnSO_4) having a diameter of one micron and a specific gravity of 3.0. The estimated rate of conversion of sulfur dioxide is 1.0 percent per minute. Since Gerhard and Johnstone (1) estimated the conversion in natural sunlight to be about 0.1 to 0.2 percent per hour, the rate of conversion by fog droplets is approximately about 500 times greater.

LITERATURE CITED

- (1) Gerhard, E. R., and Johnstone, H. F., *Ind. Eng. Chem.*, 47, 972 (1955). 88 pages. \$1.50. Mic 56-2583

A STUDY OF PHASE AND SOLUBILITY
BEHAVIOR OF TAR ACIDS AND TAR
HYDROCARBONS IN LIQUID PROPANE

(Publication No. 17,245)

David Ho-Feng Liu, Ph.D.
University of Pennsylvania, 1956

Supervisor: Dr. A. Norman Hixson

The phase and solubility behavior of various chemicals in liquid propane have been reviewed. The solubility behavior of various types of compounds in liquid propane was categorized in accordance with their hydrogen-bond-forming capabilities.

The usefulness of liquid propane for the selective extraction of coal-tar fractions was tested using synthetic tar mixtures which consisted of one typical tar acid and one typical tar hydrocarbon.

The equilibrium data of the following systems at 30°C were measured and are reported in terms of weight percent. The data are plotted on the triangular diagrams. The tar acids in these systems were so chosen as to illustrate the effect of structure of the tar acid on the equilibrium distribution of tar hydrocarbon. The systems studied were:

1. Propane-m-Cresol- α -Methylnaphthalene
2. Propane-Phenol- α -Methylnaphthalene
3. Propane-p-Cresol- α -Methylnaphthalene
4. Propane-1-Naphthol- α -Methylnaphthalene

The results of binary solubility studies indicated that the separation would be poorest with system containing m-Cresol as the tar acid. Consequently, the equilibrium distribution of this system was investigated at three temperature levels to ascertain the possibility of improving the selectivity through lowering the temperature.

Also reported are the results of equilibrium studies of the following two systems conducted at 15°C:

5. Propane-m-Cresol-n-Dodecane
6. Propane-m-Cresol-n-Hexadecane

The results of this investigation indicate that propane is a promising solvent for the separation of pure tar acids from their mixtures with tar hydrocarbons. However, because of the fact that the region of immiscibility for the ternary systems is limited, the hydrocarbons cannot be separated as pure compounds.

141 pages. \$1.90. Mic 56-2584

DEPOSITION OF AEROSOL
PARTICLES ON SCREENS

(Publication No. 17,392)

Charles Gridley Marshall, Ph.D.
The Ohio State University, 1956

Experimental data were obtained for the deposition of aerosol particles on screens. Screen wire diameter,

screen porosity, and superficial velocity were varied independently. Screen wire diameter was varied from 0.00905 cm. to 0.16 cm. at one porosity; screen porosity was varied from 0.228 to 0.589 at one wire diameter; superficial velocity was varied from 1.0 cm./sec. to 600 cm./sec. in both sets of data. The aerosol consisted of supercooled droplets of "Oil Orange" dye in air. The aerosol concentration was about 1.7 mg./cu. ft. The average particle diameter was 0.29 micron, determined with a jet impactor.

At comparable values of the deposition parameters, the data agreed within 30 per cent with data on deposition in fibrous beds previously obtained at this university. The deviation was in the direction to be expected from the differences in porosity between the screens and the fibrous beds.

The data agreed to ± 50 per cent with the Langmuir theory of diffusional deposition and flow line interception, if a correction factor of 1.75 was applied to the target efficiencies calculated from the theory. It was found that experimental data in the literature for deposition in fibrous beds also agreed qualitatively but showed target efficiencies higher than predicted by the theory.

The Langmuir theory reproduced the trend of target efficiency with superficial velocity found in the present investigation, but experimental target efficiencies decreased somewhat less rapidly than the theory predicted with increasing wire diameter and screen porosity. No explanation was found. Calculations indicated that gravitational, thermal, and electrical depositions were too small or too variable to account for the deviations. Introduction of a Reynolds number effect into the Langmuir theory did not yield a correlation.

In the course of the investigation, new data were obtained on pressure drop through screens at low Reynolds numbers, and a previously unreported phenomenon in the operation of jet impactors was discovered, collection efficiency being found to increase rapidly with increase in the amount of material collected. It is believed that the increase in efficiency is caused by collection on the particles already deposited and by the effect of the deposit on the geometry of the apparatus.

302 pages. \$3.90. Mic 56-2585

ENGINEERING, CIVIL

A CORRELATION OF PEDOLOGIC SOIL TYPES
WITH RIGID PAVEMENT PERFORMANCE
IN DEWITT COUNTY, ILLINOIS

(Publication No. 18,123)

Nicholas Chryssafopoulos, Ph.D.
University of Illinois, 1956

The purpose of this thesis is to try to determine if any correlation exists between pedologic soil types and rigid pavement performance in DeWitt County, Illinois.

Three highways of different age and design were studied. All factors affecting the performance of a pavement, with the exception of subgrade soils, were assumed to be constant in each of these three highways.

A pavement condition survey and a soil survey were made along the right-of-way of each highway. The different forms of pavement failure were located and sketched as they actually appear. The boundaries between the different soil types along the three highways were drawn on the pavement condition maps.

The performance of each pavement was analyzed as to soil type and horizon. Results of this analysis show that the drainage condition, particularly the position of the water table and the water holding capacity of a soil, is one of the most important factors affecting pavement performance. A good correlation was found in one of the highways between the number of transverse cracks per 100 ft. and soil type when the pavement is placed on the A horizon of the soil profile. There is no consistent correlation between the same variables when one or more soil horizons have been removed, thus disturbing the natural drainage condition. The intensity of transverse cracking was found to increase as the pavement is placed lower in the natural profile.

No conclusive correlation could be established between longitudinal cracking and soil types because of the small amount of this type of cracking.

All other forms of failure were of such limited extent that conclusions could not be drawn. However, 35% of all pumping occurs in pavements placed on Ag. No. 233, Birkbeck silt loam.

Fill sections were found to perform better as subgrades than sections in cut and grade. There is a higher intensity of cracking at transitions from cut to fill, both on the cut and the fill side.

Because of lack of pronounced contrast among the different horizons of the soils mapped, there was no increase in failure observed which could be attributed directly to profile contrast. 136 pages. \$1.80. Mic 56-2586

THE EFFECTS OF WEATHER UPON RAILROAD OPERATION, MAINTENANCE, AND CONSTRUCTION

(Publication No. 18,148)

William Walter Hay, Ph.D.
University of Illinois, 1956

This study has been prepared to show the effects of temperature, ice, snowfall, wind, and moisture upon the design and costs of road and equipment, maintenance and operating practices, train movements, and safety of United States railroads. Railroad operation does not lend itself to establishing absolutes. There are too many variables and unknowns involved. Nevertheless some conclusions can be reached by a consideration of personal experiences of the writer and of individual railroads as obtained by letter and questionnaire, by analysis of railroad files, daily situation reports and broken rail reports, descriptions of storms, and of Interstate Commerce Commission statistics.

With the exception of certain combinations of unusually severe conditions, trains do not stop running because of weather. Railroads operate regular schedules from -70 deg. F to 136 deg. F. Delays occur but under normal conditions these are nominal, usually being only a few minutes and seldom exceeding 24 hours, especially when

traffic can be re-routed over other lines. However the importance of minor delays should not be underestimated. The severity of weather effects varies with the preparation and planning for those conditions.

The detailed study cites many situations not of disaster proportions which can cause delays. The reason trains are not delayed more than they are lies in the organization of men, materials, and equipment to carry on a continual and unremitting routine battle against adverse weather situations which might cause blockades.

A principal factor is the high morale and willingness to take initiative and assume responsibility which characterizes the personnel. Modern snow fighting equipment, including the almost universal use of mechanized work equipment, is another factor.

The worst effects of weather occur when several elements such as snow, wind, and low temperature combine in one storm. Major, but infrequent, disasters are occasioned by tornadoes, hurricanes, and floods - or a combination of these.

Some few situations can tie up a railroad and delay trains for more than a nominal period: (a) Destruction of a major bridge structure by floods, fires, windstorm, etc. definitely halts train movements over that line until the bridge can be repaired or renewed. (b) Severe floods can wash out long stretches of track requiring several days to a month or more to rebuild. (c) Excessive snowfall and drifting have caused delays of one day to a week on main lines and up to a month on branch lines. (d) The loss of signal and communication lines, as in ice storms, halts or seriously impairs train operations for as much as a week to ten days. (e) Severe sand and dust storms can halt all train movements and other activities while the storm is at its peak due to loss of visibility and to drifting sand.

About 13 percent of reportable train accidents in a 5-year period were caused by weather conditions of which 8.6 percent were collisions due to poor visibility and 2.2 percent arose from floods and washouts.

The railroads bear a considerable cost burden due to weather which is an inherent characteristic of an individual railroad's location. Certain major disasters may be termed "acts of God" and are deserving of some special public relief. 338 pages. \$4.35. Mic 56-2587

ENGINEERING, ELECTRICAL

DISTRIBUTIONS AND THEIR LAPLACE TRANSFORMS

(Publication No. 18,108)

Reuben William Aboudi, Ph.D.
University of Illinois, 1956

The distribution theory is treated in a simplified but mathematically rigorous manner, in this self-contained account. The approach to the theory is most closely related to that of L. Schwartz in his book "Theorie des Distributions" (Hermann et Cie, 1950, 1951). However, general distributions are used, that is, linear functionals defined over a vector space of certain testing functions,

instead of Schwartz's continuous linear functionals. No use is made of topological considerations or deep-lying theorems on functionals. The use of Stieltjes measure and Lebesgue integration is completely avoided. Such operations as addition, multiplication, differentiation, and integration of general distributions are discussed and shown to be consistent with the corresponding operations for classical continuous point functions whenever the general distributions are identifiable with continuous point functions. The concept of definite integrals of distribution is introduced for a special kind of distribution.

A method for finding the Laplace transform of certain distributions based on the concept of definite integrals is given. A more general way of finding the Laplace transform of a general distribution and its inverse transform is discussed. This necessitates the use of a different class of testing functions, and the notion of general distributions is extended into the new class.

Applications are discussed briefly. It is shown that the distribution theory can be used in electrical circuit analysis where the classical theory of differential equations is not adequate, that is, when the forcing function is discontinuous or an "improper function."

Measuring instruments are shown to give functionals with testing functions that depend on the type of the particular instrument. 100 pages. \$1.50. Mic 56-2588

ELECTRIC AND MAGNETIC PROPERTIES OF SOME ALKALINE EARTH TITANATES

(Publication No. 18,122)

Alexander Stanley Chodakowski, Ph.D.
University of Illinois, 1956

In this investigation measurements were made, within the approximate temperature range -195°C to 400°C , of the electrical resistivity and the magnetic susceptibility of non-stoichiometric, polycrystalline samples of five alkaline earth titanates; namely, BaTiO_3 , SrTiO_3 , CaTiO_3 , MgTiO_3 , and Mg_2TiO_4 . Deviations from stoichiometry were achieved by reduction of samples in a hydrogen atmosphere at various temperatures.

Since the samples were small, the Faraday method was used along with modified versions of a Curie-Cheneveau balance to measure susceptibility. The Honda-Owen method was employed to correct measured susceptibilities for the influence of minute ferromagnetic impurities which were found in some of the samples. Wiedemann's law was used to calculate the ionic susceptibility of the Ti^{3+} ion, and the method of Angus was used to find the diamagnetic susceptibilities of constituent atoms.

The measured magnetic susceptibility was observed to be dependent on degree of reduction.

For the first three titanates mentioned above, the diamagnetic corrections were appreciable in comparison with the measured susceptibilities; hence the interpretations of the data were inconclusive. For the magnesium titanates, the diamagnetic corrections were relatively small; hence the data were more trustworthy. The inverse susceptibility versus temperature plots for MgTiO_3 and Mg_2TiO_4 seem to indicate definite deviations from a Curie-Weiss law at low temperature. 149 pages. \$2.00. Mic 56-2589

DETERMINATION OF ULTRASONIC DOSAGE RELATIONS FOR THE MAMMALIAN CENTRAL NERVOUS SYSTEM

(Publication No. 18,129)

Floyd Dunn, Ph.D.
University of Illinois, 1956

The use of ultrasound in the fields of biology and medicine has increased greatly during the past decade. Ultrasound has been used clinically in such diversified fields as in the treatment of superficial cancers and in dental drilling. As a research tool, ultrasound has been used in biological investigations in the fields of muscle physiology, bacteriology, virology and hematology. While many of the results of this earlier work are of a dubious nature, more recent application in the fields of neuroanatomy and neurophysiology indicate that when properly controlled, ultrasound can produce unique results in biological systems. If the full potentialities of the ultrasonic methods are to be realized, it is essential that precision instrumentation and techniques be available to the investigator and that the physical mechanism of the action of the sound on the tissue be understood.

The work described and the results presented in this dissertation relate to the initiation of an elaborate series of experiments which has been designed to yield information regarding the fundamental physical mechanisms involved in the irradiation of biological materials with ultrasound. The purpose of this thesis is to demonstrate that it is possible to realize accurately reproducible results on a suitably prepared and precisely irradiated biological specimen.

The subject used in this study is an intact mouse approximately 24 hours after birth. The spinal cords of the animals are irradiated with ultrasound with the center of the beam positioned at the third lumbar vertebra. The functional endpoint observed is motor paralysis of the hind legs. The experiments were carried out at a base temperature of 10°C ., a frequency of 982 kc/s and a hydrostatic pressure of one atmosphere in a plane traveling wave field. The acoustic intensities ranged from approximately 25 watts/cm² to 125 watts/cm² and the time duration of exposure to the ultrasound was varied from approximately one second to 1,000 seconds.

The results show that a well defined threshold region exists. The threshold region is defined as follows: If a large number of animals are irradiated with identical values for the acoustic field variables for various periods of time, and the percentage of animals paralyzed at each duration of exposure is plotted as a function of the reciprocal of the time duration of exposure, a sigmoidal curve is obtained. The threshold range at the chosen values for the acoustic field variables is arbitrarily defined as the range of time durations of exposure from 10% of the animals paralyzed to 90% of the animals paralyzed. The collection of these threshold ranges, for various values of a specified acoustic variable, defines the threshold region for that variable.

The experimentally determined threshold region (with the square root of the intensity as the acoustic field variable) shows that a linear relationship exists between the reciprocal of the exposure time and the square root of the acoustic intensity. For 50% of the animals paralyzed, the linear relationship extends from approximately 48

watts/cm² (25 seconds time duration of irradiation) to 125 watts/cm² (1.1 seconds time duration). At the lower extremity of the linear portion, the threshold region deviates from linearity. The width of the threshold region in the linear portion, for a single value of the acoustic intensity, is only 18%. Temperature measurements made by imbedding small thermocouples in the cords of the mice indicate that damaging temperature levels are not reached for dosages in the linear portion of the threshold region. The data represents results obtained from experiments on 1048 animals. The work was carried out in the absence of cavitation. 54 pages. \$1.50. Mic 56-2590

CAPACITOR SWITCHING PHENOMENA IN NETWORKS CONTAINING LONG TRANSMISSION LINES

(Publication No. 17,184)

Olle Ingemar Elgerd, Sc.D.
Washington University, 1956

Chairman: Doctor John Zaborszky

This research is a contribution to the knowledge of the problems arising in connection with switching of large capacitor banks. It is possible to effectively reduce the surges of voltage and current by so-called two-step switching whereby suitable auxiliary resistors are inserted in the circuit during the switching operation.

The analysis is centered on a study of two-step switching where relatively long supply lines are used. With very high transmission voltages and extremely long lines in prospect for the near future, it has been considered of interest to augment the present theory on the subject with an analysis of the switching transients when the continuous distribution of line parameters is taken into account.

Presently existing theory usually is based on the assumption of lumped line parameters. It is shown in this paper that this assumption may be suitable for short lines but definitely renders erroneous results in the case of long supply lines.

A relatively simple yet representative circuit configuration is chosen for the analysis. This is done in order to avoid the necessity of using a high-speed digital computer for the numerical computations.

The experimental part of this research consists of an investigation into the suitability of using a DC analog computer for the simulation of electrical transients in networks containing continuous elements. The results look very promising. 201 pages. \$2.65. Mic 56-2591

SOME ASPECTS OF THE ROOT LOCUS METHOD APPLIED TO THE STUDY OF LINEAR AND NONLINEAR FEEDBACK CONTROL SYSTEMS

(Publication No. 18,299)

Albert Smith Jackson, Ph.D.
Cornell University, 1956

The root locus method is a powerful method of analysis and synthesis of feedback control systems. However, the

method has yet to be widely accepted and used by people in the field. It is felt that the reason for this is that the full potentialities of the method have not been exploited.

The purpose of this thesis is to extend the usefulness of the root locus method by showing how the root location information can be used to tie together the time and frequency domain concepts. It is demonstrated how the closed loop frequency response can be easily obtained from the root locus plot and how this use of the root locus method can be effectively utilized in the study of both linear and nonlinear systems. Many of the concepts involved are brought out in an analysis of the commonly used methods of compensation. A simple linear system is chosen as an example with a forward loop transfer function of the form:

$$G(s) = \frac{K}{s(T_1 s + 1)(T_2 s + 1)}$$

Specific values for T_1 and T_2 are chosen to illustrate first the approach to preliminary analysis. Then a detailed study of various means of compensation is made including the effects of rate feedback damping, series and parallel compensation with lead networks, and series and parallel compensation with lag networks. Results of an analog computer simulation of the system are used to extend the analysis by verifying predictions made on the basis of the analytical work and to form a basis for the correlation between closed loop frequency and transient response.

The extension of the root locus method to the frequency domain is also shown to be quite useful in the study of nonlinear systems. The model chosen for illustration is that of a system powered by a two-phase servo motor. The nonlinearity considered arises from the fact that the torque-speed curves are not linear. In the analysis, it is assumed that the torque can be expressed as:

$$T = K_1 E - \alpha_1 \dot{\Theta} - \alpha_2 (\dot{\Theta})^2 - \dots - \alpha_n (\dot{\Theta})^n$$

where E is the voltage impressed on the control winding of the motor and $\dot{\Theta}$ is the motor shaft speed.

The analysis is first carried out using root locus techniques in conjunction with the describing function method. The analysis is then carried through using the Nyquist plot and the essential differences between the two methods are pointed out. An error analysis is then made based upon the method of Equivalent Linearization. This error analysis consists of examining the periodic solutions of the force-free system and comparing the first order frequency and gain corrections thus obtained with the results of the previous analysis for a specific set of parameters. Finally, the results of an analog computer study of the system are presented and compared with the analytical work.

Conclusions

The root locus method is a powerful method of analysis and synthesis of feedback control systems. Its usefulness is greatly extended if the information contained in the root location is used in both the frequency and time domains. The transform of the closed loop transfer function is obtained directly from the root locus plot. This in turn can be used to evaluate the output for any input and associated initial conditions. However, without actually evaluating

the inverse transform, the general form of the transient response may be obtained by noting the relative placement of the closed loop poles and zeros. And by relating the pole-zero positions to break points on the log frequency plot, the analyst is able to sketch the frequency response. The result is a better understanding of the problem. Synthesis becomes more straightforward and a considerable time savings is achieved, especially for systems with non-unity feedback.

The study of nonlinear problems can also benefit from this approach. In the past, frequency response techniques have been used almost exclusively for analysis of nonlinear systems. It has been demonstrated that the root locus method is quite useful if it is combined with the concept of the Describing Function.

Aside from the advantages derived from the study of particular systems, the extension of the root locus method to obtain the frequency response of the closed-loop system offers a simple and very effective means of establishing correlation between the transient response and frequency response of feedback control systems.

111 pages. \$1.50. Mic 56-2592

TRANSIENT RESPONSE OF PSEUDO-LINEAR FEEDBACK CONTROL SYSTEMS

(Publication No. 18,162)

John Belshaw Kreer, Ph.D.
University of Illinois, 1956

Pseudo-linear feedback control systems are systems which are designed to be linear, but which possess unavoidable nonlinearities. Under certain operating conditions these nonlinearities have considerable effect on system performance. Previous methods of analyzing pseudo-linear systems are reviewed in this thesis. Most of these methods employ the use of describing functions. Describing functions are transfer functions for nonlinear elements which relate the fundamental components of the response of the nonlinear element to a sinusoidal driving function, and are a function of the magnitude of the latter.

It is shown that considerable information about the same systems, which have been analyzed previously by describing function methods, can be found through the use of an equivalent signal concept. The equivalent signal concept substitutes a linear system with a modified or equivalent driving function for the pseudo-linear system and a specified driving function. The linear system and equivalent signal are chosen so that the same differential equations and boundary conditions must be used to describe the performance of the linear system as are required for the pseudo-linear system. The equivalent signal is derived from the driving function and the nonlinearity considered.

Once the linear system and the equivalent signal have been specified, the response can be found by use of Duhamel's theorem. It is also possible to estimate critical features of the response using theorems which are applicable only to linear systems.

The latter possibility is illustrated by the maximum response ratio for linear systems. By combining the use of the maximum response ratio and the equivalent signal

concept, it is possible to establish close upper bounds on the effects of many nonlinearities.

It is shown that pseudo-linear systems can have a steady state error that may be either constant or oscillatory in form. It is pointed out that describing function analysis fails to indicate the presence of a constant steady state error and that the instability indicated by describing function analysis in many cases could be considered to be a steady state error which is oscillatory in form.

It is suggested that a more precise definition of stability would be helpful in classifying the performance of pseudo-linear systems. A distinction should be drawn between systems in which the response increases indefinitely with time until some component fails, and systems in which there is a bounded, oscillatory steady state error.

The equivalent signal method is illustrated by analysis of second order systems containing saturation, friction controlled backlash, or inertia controlled backlash as the nonlinear element. The step displacement response is found for all three nonlinearities. The step velocity response is found for friction controlled backlash, and the general features of the step velocity response are indicated for inertia controlled backlash. The use of the maximum response ratio is illustrated by several examples.

103 pages. \$1.50. Mic 56-2593

RADIOMETRIC MEASUREMENT OF 8.7 MM ATMOSPHERIC ATTENUATION

(Publication No. 17,475)

Gene Ray Marner, Ph.D.
State University of Iowa, 1956

Chairman: Professor L. A. Ware

A description is given of the experimental measurement of atmospheric attenuation in the 8.7 mm wavelength region. A combined radiometer-radio sextant capable of tracking the sun accurately by reception of the solar 8.7 mm radiation also measures the received power. As the sun sets, the atmospheric attenuation traversed by the radiation increases, causing the received power to decrease. The attenuation constant as a function of height above the surface of the earth is derived from these data. During clear or overcast conditions, the sea level attenuation constant ranged from 0.027 to 0.072 db/km depending primarily upon the absolute humidity. The molecular oxygen attenuation, obtained by extrapolating to zero absolute humidity, is approximately 0.02 db/km, in agreement with theory. The effects of snow, rain and thunderstorms are also discussed.

71 pages. \$1.50. Mic 56-2594

THE FRESNEL REGION OF LARGE APERTURE ANTENNAS

(Publication No. 17,265)

Charles Polk, Ph.D.
University of Pennsylvania, 1956

Supervisor: Dr. P. P. Lombardini

In section 1 a brief history of diffraction theory is outlined and the appearance of Fraunhofer and Fresnel diffraction phenomena due to microwave antennas is explained. The problems considered in the thesis are presented.

In section 2 the derivation of the Kirchhoff diffraction formula through Green's theorem is reviewed and its limitations are investigated. The scalar formula is compared with a vector expression which is correct for electromagnetic diffraction problems. The contributions of usually neglected line integrals around the aperture boundary are evaluated for symmetrical and symmetrically illuminated apertures. The error which results when these integrals are neglected is related quantitatively to the aperture size (equations 2-36 to 2-39) and to observation distance. It is also shown that the contribution of the line integrals is exactly equal to zero in certain symmetry planes.

In section 3 the Fresnel-zone gain of an aperture is defined and equations relating the ordinary far-zone gain to the Fresnel-zone gain are derived. Necessary mathematical functions related to the Fresnel integrals are defined and computed. Apertures with uniform, tapered, cosine and cosine square amplitude distributions are considered. Comparisons with circular apertures are made and the results are discussed in a semi-qualitative way in terms of annular Fresnel-zones. The application and modification of the Friis transmission formula in the Fresnel region is considered.

In section 4 formulas for the amplitude and phase of the field in planes parallel to a rectangular aperture are derived; the aperture distributions of section 3 are again considered in this problem. The results are presented in tabular and graphical form.

In section 5 some experiments are described briefly and the results are discussed.

In section 6 those limitations of the formulas derived in sections 3 and 4 are considered which are not due to the limitations of the Kirchhoff equation itself, but are due to the approximations employed in the evaluation of the integrals for specific cases. Minimum observation distances at which the formulas may be used are expressed in terms of aperture size and wavelength. Problems allied to the subject of this thesis which could be the object of future research are described. 117 pages. \$1.50. Mic 56-2595

AUTOMATIC ELECTRONIC TELEPHONE SWITCHING SYSTEMS

(Publication No. 17,278)

Lester Malvern Spandorfer, Ph.D.
University of Pennsylvania, 1956

Supervisor: Morris Rubinoff

The thesis contains original solutions to some of the

major issues which arise in the planning of the overall logic and engineering design of an automatic electronic telephone office. The dominant issues are primarily concerned with the general design philosophy of a moderately small exchange using semiconductor diodes and triodes to the maximum possible extent. The results are extended in many cases to larger size offices and to components other than transistor-like devices. In many instances, ideal semiconductor characteristics are postulated for (1) simplicity and (2) in the belief that continued progress in component development will result in device characteristics which tend to approach the ideal. In these instances, the limitations of available and soon-to-be available components are pointed out.

Section 1 serves to introduce basic telephone switching office concepts to the reader. The broad fundamental techniques which are used in certain classes of existing systems are described, along with an introduction to trunking and blocking concepts.

Section 2 is devoted to methods of reducing the size of the talking path or interconnecting network. The structure, crosspoint requirements, and blocking characteristics of interconnecting networks are analyzed in detail. Adaptations and modifications of 3-stage Clos crosspoint networks for small offices are described. A method of computing the blocking in 3-stage open and closed networks is given. The analysis indicates that the results obtained are more useful for small offices than those of previously published methods.

The general system philosophy material of Section 3 is largely concerned with the basic requirements for an office of optimum design. A detailed analysis is presented on the interplay and conflicting requirements between the interconnecting network and the remaining structure of the office. The concept of centralized and decentralized crosspoint memories are explored. The effect of the crosspoint bias current and supervisory functions on the size and operation of the interconnecting network is described. The development of the office philosophy is culminated in a description of the desirability and advantages of the competing lockout method, in which the interconnecting network consists of a matrix of negative resistance crosspoints which do not require individual access. The logical details of a complete 100 line office using this principle are given; the critical portions of the system have been successfully bench-tested. The section concludes with a variation on the basic matrix and a discussion of general register philosophy.

164 pages. \$2.15. Mic 56-2596

STATISTICAL OPTIMIZATION OF SAMPLED-DATA CONTROL SYSTEMS OPERATING IN THE PRESENCE OF RANDOM NOISE

(Publication No. 17,203)

Simeon Elisha Watson, Jr., Sc.D.
Washington University, 1956

Chairman: Dr. John Zaborszky

The least-mean-square-error criterion of Wiener is extended to sampled-data systems in which the continuous

input is represented by an infinite sequence of impulses. As in the case of continuous systems, the signal plus noise comprising the input is restricted to stationary random functions of time.

Prior to extension of the theory of Wiener, the basic statistical parameters are developed for sampled-data systems through examination of the physical sampling process. Because the resulting expressions for the correlation functions and spectral densities are infinite sequences rather than closed-form equations, a method is found whereby the spectral densities may be derived from the continuous correlation functions by the expedient of taking the z-transform. It is shown that the method is exact provided the sampling rate is in accordance with the "sampling theorem" of communication theory.

The extended theory of Wiener is then applied to three cases which have been treated in the literature on continuous systems. In each case, the signal is taken to be a Markoffian function which, although analytically simple, is not bandwidth limited. It is shown that the previously mentioned method for finding a closed-form expression for the spectral densities may be used; however, some uncertainty is inserted into the problem.

Finally, it is shown that the optimum transfer function found by the extended theory of Wiener, which is the transfer function of an open-loop sampled-data system, may be interpreted as either one of two types of closed-loop systems. One system involves a digital computer in the forward loop while the other is comprised entirely of analogue elements. When the digital computer is employed, the system will not be optimum in general. However, in the analogue case, the optimum transfer function can be obtained exactly, even though a portion of the forward loop is unalterable.

220 pages. \$2.85. Mic 56-2597

ENGINEERING, MECHANICAL

MODEL STUDY OF HEAT TRANSFER IN PANEL HEATED SPACES

(Publication No. 17,490)

Ahmad Raafat Shouman, Ph.D.
State University of Iowa, 1956

Chairman: Dr. Don H. Madsen

The object of the study was to investigate the application of the theory of models to the behavior of panel heated enclosures. Three similar, but different size, models were built for the study. The models were cubical inside enclosures. The walls were made of plywood whose thickness was in proportion to the size of the model. The floor was the heating panel in each model. The surface of the panel was made of copper to maintain as uniform temperature as possible and it was electrically heated. The temperature was measured at different elevations in the model, on the walls of the model and at several points within the pressure tank in which the model was tested.

Each model was tested at four different pressures maintained inside the tank and at different heat inputs to

the panel. For each heat input the different thermocouple readings were recorded.

After analyzing the results of the study, it was found possible to correlate the Nusselt and Grashof numbers for the range of size of models tested. The relation that existed between the two dimensionless groups was expressed by:

$$N_{Nu} = C (N_{Gr})^n$$

where:

N_{Nu} = Nusselt number

N_{Gr} = Grashof number

C and n = constants.

The Nusselt and Grashof numbers based on the temperature difference between the outside air temperature and the panel surface temperature gave better correlation than those based on the difference between the average inside air temperature and the panel surface temperature. It was also found that the relation between the temperature inside the model and the height at which it was measured, when arranged in suitable dimensionless groups, was the same for all the models. The dimensionless groups used for the

correlation was $\frac{x}{H}$ and $\frac{t_p - t}{t_p - t_a}$ where:

x = height of considered point above the panel surface

H = inside height of model

t_p = panel surface temperature

t = temperature at considered point

t_a = average inside temperature of the model.

96 pages. \$1.50. Mic 56-2598

ENGINEERING, MECHANICS

ULTIMATE STRENGTH OF LONG REINFORCED CONCRETE COLUMNS

(Publication No. 18,115)

Bengt Baltzar Broms, Ph.D.
University of Illinois, 1956

The purpose of the investigation was to determine theoretically the ultimate strength of long concentrically and eccentrically hinged and restrained reinforced concrete columns, to compare the theory with test data, to study the effects of variables known to influence the ultimate load, and to develop a simplified design procedure.

Methods are presented for computing the ultimate strength of long reinforced concrete hinged and restrained columns. They are based on an exact theory taking into account the plastic properties of concrete and steel. In the theory the following assumptions have been made: 1) the stress-strain relationship for concrete can be approximated by the relationship derived from tests of short reinforced concrete columns, 2) the stress-strain relationship for steel can be assumed trapezoidal with the flat portion equal to the yield point stress, 3) the distribution of strain across the section is linear, 5) the effect of

shear on the deflection is negligible, and 6) the restraining moment is proportional to the end rotations.

The theory is compared with the results of tests of 54 concentrically and of 79 eccentrically loaded long hinged columns covering wide ranges of major variables. The test data obtained in six different investigations at different institutions in the period 1931-1954 are in good agreement with the theory thus indicating that the theory for hinged columns with its basic assumptions yields reliable results.

For hinged columns the effects on ultimate load of the following eight major variables were investigated quantitatively: strength of concrete, yield point of steel, percentage of longitudinal reinforcement, slenderness of column, effective depth of reinforcement, creep of concrete, eccentricity of load and shape of moment diagram. For restrained columns the effects on the ultimate load of the following six major variables were investigated quantitatively: strength of concrete, yield point of steel, percentage of reinforcement, end restraint, eccentricity and slenderness. The corresponding short column strength, the slenderness ratio, and the moment diagram were found to have the most important effect on the ultimate strength of long hinged columns.

The ultimate strength of restrained columns can be predicted safely as the strength of a corresponding hinged column with the eccentricity of the load determined on the basis of the theory of elastic displacements. The ultimate strength of hinged columns can be determined as the product of the short column strength and a reduction coefficient. The short column strength may be determined either as the allowable load based on the 1951 ACI Building Code or as the ultimate load based on the Report ASCE-ACI Joint Committee on Ultimate Strength Design. The reduction coefficient may be determined from the following equation:

$$\frac{P_{\text{long}}}{P_{\text{short}}} = 1.0 - 0.030 a \leq 1.0$$

where

$$a = \ell/d - 15 + 5 e_1/e_2$$

143 pages. \$1.90. Mic 56-2599

BENDING AND VIBRATION OF SKEW CLAMPED PLATES

(Publication No. 18,313)

Gaylen Aubrey Thurston, Ph.D.
Cornell University, 1956

This thesis considers the problems of the bending and vibration of clamped skewed plates. Skew coordinates are used which map the oblique parallelogram plate in the x-y plane into a rectangle in the u-v plane.

The Lagrangian multiplier method is used. This is an energy method similar to the Rayleigh-Ritz method, except that it allows the series with undetermined coefficients, which is assumed for the deflection of the plate, to satisfy the boundary conditions as a whole rather than term by term. By slightly relaxing the boundary condi-

tions it is possible in some cases to obtain a lower bound for the first natural frequency as well as the usual upper bound obtained by the Ritz method.

The deflection w is assumed as a double Fourier series. For deflections symmetrical about the axis perpendicular to the plate through its center this series is

$$W = \sum_{m=0,2,4}^{\infty} \sum_{n=0,2,4}^{\infty} a_{mn} \cos \frac{m\pi u}{a} \cos \frac{n\pi v}{b} \\ + \sum_{p=1,3,5}^{\infty} \sum_{q=1,3,5}^{\infty} b_{pq} \cos \frac{p\pi u}{a} \cos \frac{q\pi v}{b}$$

For the limiting case of the rectangle there are solutions for which the b_{pq} 's are zero. It was assumed that this might be nearly correct for small angles of skew. Results were obtained under this assumption for several different cases. For the rectangle these are easy to obtain and check previous studies very well.

Equations were also derived using the complete set of functions. The a_{mn} 's and b_{pq} 's are coupled in the strain energy expression so that the solution becomes very laborious. Results were obtained for a plate of equal sides with a skew angle of 30 degrees under a uniform load by solving 42 simultaneous equations by means of an electronic computer. This solution shows that the b_{pq} 's are not negligible.

The conclusion is that the Lagrangian multiplier method compares favorably with other methods for clamped rectangular plates. For skew plates it appears possible to obtain approximate results for static deflections but the computation is much more involved.

45 pages. \$1.50. Mic 56-2600

ENGINEERING, METALLURGY

DETERMINATION OF HETEROGENEOUS EQUILIBRIUM FROM ELECTROMOTIVE FORCE MEASUREMENTS

(Publication No. 18,114)

Robert Walter Bohl, Ph.D.
University of Illinois, 1956

Thermodynamic properties of liquid alloys and liquid-solid phase equilibrium were studied in binary zinc-cadmium and zinc-indium alloys by the measurement of electrode potentials of galvanic cells of the type:

$\text{Zn(liquid)}/\text{ZnCl}_2(\text{in KCl-LiCl liquid})/\text{Zn(in liquid solution)}$.

Measurements were carried out over a range of temperatures from 420° to 530° C. Partial molar free energies and enthalpies and the activities of zinc, the more electropositive component of the alloys, were calculated on the basis of the following relations:

$$\Delta \bar{F}_{\text{Zn}} = -nE \quad \bar{F}_{\text{Zn}} = n \int [T(dE/dT) - E] \\ \text{(pure liquid Zn as standard state)}$$

Similar properties of the other component of the alloys

were then calculated by the following graphical integrations:

$$\ln(a_2/N_2) = - \int_0^{N_{Zn}} (N_{Zn}/N_2) d\ln(a_{Zn}/N_{Zn})$$

$$\bar{L}_2 = - \int_0^{N_{Zn}} (N_{Zn}/N_2) d\bar{L}_{Zn}$$

Partial molar entropies were then evaluated from:

$$\Delta \bar{S}_i = (\bar{L}_i - \Delta \bar{F}_i)/T$$

To establish liquidus points, the activity of zinc in solid solution was calculated as a function of temperature in the liquidus-solidus range on the basis of the heat of fusion and heat capacity data available for pure zinc, and the solid solubility of the solute in pure zinc. The activity of zinc in each of the liquid alloys was also plotted as a function of temperature, and extrapolated to the point of intersection with the activity of the solid phase. This intersection thus determined the temperature at which liquid and solid phases were in equilibrium. The liquidus points thus determined are in excellent agreement with published values based on thermal analyses.

In view of the discrepancies in published values of ΔH_f for pure zinc, the emf. data was used to calculate ΔH_f , by assuming values of liquidus points based on thermal analyses and carrying out essentially the inverse of the calculation described above. Values of ΔH_f thus determined for several alloys showed much less scatter than published results based on calorimetric techniques.

The properties of the liquid alloys were examined with regard to solution theory, and zinc-cadmium shown to closely approach regular behavior, while zinc-indium alloys showed some deviation from this type of behavior. Both systems showed moderate positive deviations from Raoult's Law, and positive heats of mixing over the entire composition range. 43 pages. \$1.50. Mic 56-2601

A KINETIC STUDY OF THE LEACHING OF MOLYBDENITE

(Publication No. 17,568)

William Henry Drescher, Ph.D.
University of Utah, 1956

Chairman: Dr. Milton E. Wadsworth

A study of the rate of dissolution of molybdenite (MoS_2) in alkaline solution under oxygen pressure was carried out under carefully controlled conditions. The effects of temperature, oxygen partial-pressure, and potassium hydroxide concentration were evaluated. Studies were made in the temperature range of from 100° to 175° C and in the pressure range of from 0 to 750 psia of oxygen. Under these conditions molybdenite was found to leach according to a linear mechanism. Both oxygen partial-pressure and potassium hydroxide concentration were found to control the rate of leaching. The mechanism of the process has been explained in terms of adsorption of oxygen at the molybdenite surface followed by a configurational rear-

rangement of the adsorbed molecules. The hydroxyl ion dependency is believed to be diffusion controlled. Laboratory batch studies have shown that molybdenite may be readily dissolved in alkaline solutions in an oxygen atmosphere under moderate conditions of temperature and pressure. Commercial application of this process to the production of ferromolybdenum and of molybdenum chemicals seems promising in view of the ease of dissolution of molybdenite and of the relatively non-corrosive conditions involved in the process. 81 pages. \$1.50. Mic 56-2602

INTERNAL FRICTION AND DIFFUSION IN ALPHA BRASS

(Publication No. 18,151)

Jun Hino, Ph.D.
University of Illinois, 1956

A study has been made of the internal friction in 31% α -brass. The relaxation time, τ , of the "order peak" has been measured over 9 cycles of ten; this corresponds to data obtained in the range 175°C to 575°C. τ is represented over this range by the expression $8.57 \times 10^{-16} \exp(37,800/RT)$ sec. The radioactive tracer coefficients of both Cu and Zn in single crystals of 31% α -brass has also been measured. These diffusion coefficients are fitted by the expression

$$D'_{Cu} = .34 \exp(-41,900/RT)$$

$$D'_{Zn} = .73 \exp(-40,700/RT).$$

Since the activation energy for the internal friction phenomenon is significantly different from that for diffusion of either of the constituent metals, it is presumed that the internal friction phenomenon is not simply related to radioactive diffusion. It is shown, however, that the diffusion coefficients which pertain to diffusion in a concentration gradient, and which can be calculated from the tracer coefficients, are more closely related to the internal friction data. On the basis of the present data, it is presumed that the order peak is a manifestation of the diffusion of the Zn atoms. 52 pages. \$1.50. Mic 56-2603

THE CATALYTIC REDUCTION OF COBALT FROM AMMONIACAL COBALT SULFATE SOLUTIONS

(Publication No. 17,572)

Thomas M. Kaneko, Ph.D.
University of Utah, 1956

Chairman: Dr. Milton E. Wadsworth

Ammoniacal cobalt sulfate solutions were reduced to metallic cobalt under hydrogen pressure in a specially designed autoclave. The rates of reduction were measured analytically by following the depletion of cobalt from solution. Linear reduction rates were obtained under the conditions of this study covering a temperature range of

150 to 245° and hydrogen partial pressures of 150 to 800 p.s.i. Colloidal graphite was added in all runs and was found to act as a heterogeneous hydrogenation catalyst. Maximum rates of reduction were obtained for an ammonia to cobalt ratio of 2 to 1, indicating that the most easily reduced cobalt complex is the diammine. It was found that the rate was also a function of the sulfate ion as well as that of the diammine. The rate determining step of the process was found to involve an intermediate

cobalt complex at the catalyst surface and was independent of the surface area of the precipitated cobalt metal. An exponential hydrogen pressure dependency is explained in terms of structural variations associated with the quinoid character of colloidal graphite. Likewise, hydroquinone and other similar organic compounds possessing reversible, oxidation-reduction properties were found to act as homogeneous hydrogenation catalysts.

80 pages. \$1.50. Mic 56-2604

FOOD TECHNOLOGY

CHEMICAL AND NUTRITIVE CHANGES IN THERMALLY OXIDIZED EDIBLE FATS AND OILS

(Publication No. 18,154)

Ogden Carl Johnson, Ph.D.
University of Illinois, 1956

A study of edible oils which had been thermally oxidized at 200° C. was carried out in order to evaluate the chemical and nutritional changes which occurred in the oil. Various representative edible oils were heated in a stainless steel container in the presence of oxygen at 200° C. \pm 10° for twenty-four hours, and the changes in iodine, carbonyl, acid and saponification value were determined. A study of the rate of these changes was also carried out on corn oil, and the changes in conjugated and nonconjugated dienoic acid content determined.

Fresh and thermally oxidized oils were mixed into a synthetic diet which contained cerelose (44%), casein (31%), the required vitamins and minerals, and fresh or heated oils at a 20% level. The diets were fed under restricted conditions to weanling male rats, and their growth compared. A series of feeding experiments were also carried out with corn oil thermally oxidized for eight, twenty-four and forty-eight hours in order to determine the effect of the length of heating time on the nutritional value of this oil. In order to eliminate possible vitamin defi-

ciency as a cause for reduced growth, groups of weanling rats were supplemented with water as well as fat soluble vitamins. Histopathological, biochemical and enzyme studies were carried out in order to determine the sites effected by the thermally oxidized oils.

Except for butter oil, growth depression was noted in rats fed thermally oxidized corn, oleo, olive and coconut oil and margarine stock. The iodine value of the oils decreased, and the acid, carbonyl and saponification values increased during thermal oxidation. The iodine value and the nonconjugated dienoic acid content of the corn oil decreased markedly during the first eight to twelve hours of thermal oxidation, and only slightly during the next twelve hours. However, the nutritive value of the oil decreased more during the second twelve hour than during the first twelve hour heating period. The evaluation of nutritional, biochemical and chemical changes observed in this study, and a comparison of the results to previous studies by other workers suggested that polymeric carbonyl compounds could be responsible for the growth depressing action of thermally oxidized oils.

Vitamin supplementation did not improve the growth of animals on the thermally oxidized oil diets. Histological examination of the animals revealed marked pathological changes in the kidneys of animals which had been fed thermally oxidized oils. 68 pages. \$1.50. Mic 56-2605

GEOGRAPHY

A GEOGRAPHIC STUDY OF THE PATTERN OF MANUFACTURING IN TEXAS

(Publication No. 17,115)

Stanley Alan Arbingast, Ph.D.
University of Washington, 1956

This study is concerned with the development, geographical distribution, and trends of Texas industry. Its purpose is to analyze the present status of manufacturing and to evaluate the diverse resources which have helped to stimulate the establishment and expansion of fabricating and processing plants. To facilitate analysis maps were pre-

pared showing leading sources of raw materials, major soils regions, climatic data, specialized farming areas, geographical regions, and distribution of manufacturing plants.

Four significant periods mark the growth of manufacturing. Prior to 1900 emphasis was on the processing of raw materials from farms and forests. Between 1900 and 1930 oil refining and the manufacture of oil field equipment emerged as major activities, and in the decade 1930-1940 the inorganic chemicals industry became important. Since 1940 industry has been characterized by the rapid expansion of organic chemicals, liquefied gases, metals (particularly aluminum, magnesium, and steel), aircraft, metal

fabrication, and apparel. Despite recent dynamic growth Texas is not highly industrialized; nevertheless, the state is industrializing at a faster rate than the nation as a whole.

The major attractive factor for industry has been the wide diversity of resources. They include earth materials such as salt, clays, sulfur, sea water, fresh water, petroleum, natural gas, oyster shell, ores, glass sands, and building stones. A second group, composed of plant and animal materials, includes fish, timber, livestock and poultry products, corn, grain sorghums, rice, wheat, oats, flax, cotton, castor beans, truck crops, nuts, and fruit. The third group, composed of industrial end-products and by-products (examples of which are ethylene, caustic soda, carbon black, and wood pulp), in turn become the raw materials for other factories.

In addition to resource diversity, other significant growth factors have been coastal location, climate, a sizeable and productive labor force, expanding local and regional markets, low power rates, and the availability of capital for investment. The greatest handicap to industrialization is the inability of certain areas, specifically the region west of the 25-inch rainfall line, to guarantee a water supply adequate to meet the needs of new factories and for growing cities.

The industrial configuration of Texas is characterized by a well defined nodal pattern. Resource- and power-oriented industries are most heavily concentrated in the Gulf Coast area with access to raw materials and water transportation; most market- and labor-oriented plants are located in North Texas. Additional nodal centers are scattered throughout the state, with the greatest number in areas of favorable centrality within the market region or near supplies of industrial raw materials.

In the future it is probable that the majority of new heavy industries will continue to locate along the coast while market-oriented plants will be more attracted to the area north and east of San Antonio.

337 pages. \$4.35. Mic 56-2606

THE QUINCY FOOD MARKET: A STUDY IN MARKETING GEOGRAPHY

(Publication No. 18,077)

Bart Jacob Epstein, Ph.D.
Clark University, 1956

Supervisor: Raymond E. Murphy

This marketing geography in depth of the Quincy food market deals with detailed population characteristics as well as spatial and sales characteristics of local retail food stores. Description and analysis of this specific market is the basic problem.

In order to utilize maximum published detail and to achieve maximum internal differentiation, census tracts were adopted as the basic analysis unit. Most population data were extracted from the 1950 censuses of population and housing, and were supplemented by field investigation.

Conversely, most of the store data were the result of original field investigation -- the major emphasis being placed on inventory of location and physical facilities and the determination of trading areas by modification of

Applebaum's technique. Both population and store data were mapped, and analysis made on the basis of mapped characteristics. Maps are the basic tool without which such a study would be impossible.

Quincy is a mature, stable city of 84,495 persons. These people have an estimated median income for families and unrelated individuals of about \$3500-\$4500 per year. Quincy's is an old population which has recently been given new impetus by the increased post-war birth rate. The population is dominantly engaged in manufacturing and commerce for support. It is about 85% native white; the largest foreign-born groups are of English culture with some Italians and Scandinavians. Residents produce an estimated \$30,500,000 of food potential -- \$6.93 per person per week.

Quincy is old structurally. One-half its dwelling units are owner occupied, and most of these are single family type. Dilapidation is about 6% for the city.

Roads in the city are good; main roads focus on Boston. There are 3.5 persons per registered automobile, and there are more cars registered in Quincy than in most cities its size in the state.

There were 206 food stores in Quincy in 1955: a decrease of 44% since 1935. Mean size of resident food stores is about 850 square feet, and median size is about 290 square feet. Most stores have a single cash register and one to two employees.

Estimated retail food sales in Quincy in 1955 were \$35,000,000. Out of this super markets accounted for 58% and all other stores, 32%.

Trading area determination indicated there were six types of super markets in Quincy:

- Downtown stores
- Highway stores
- Stores on main city streets
- Stores in major outlying centers
- Stores in minor outlying centers
- Special service stores

On the basis of trading area determinations food potential was traced to its point of disbursement:

Super markets	\$13,596,000
Other stores	10,907,000
Milkmen	3,000,000
Scattered outlets	3,035,000
	<u>\$30,538,000</u>

Quincy food stores are ubiquitous, but also concentrate. Groceries, groceries with meat, and bakeries are the most independent type stores; all others associate with the former two types. Super markets concentrate in the central business district.

The number of people per food store reflects socio-economic rank. In most cases high numbers of people per store associate with high rank, and low numbers with low rank.

Further, disbursement of resident food potential is most easily measured in low ranked socio-economic areas.

Market changes are in progress: groceries with meat are becoming dominant; business mortality continues at a decreased rate; and super markets dominate the food market.

The southern half of the city is well serviced by local food retailing facilities, whereas there is untapped potential in the north, indicating a link between mobility and

socio-economic characteristics.

Census tracts are demonstrated to be very useful tools in micro studies in marketing geography regardless of some serious shortcomings.

Finally, similar studies are necessary before firm marketing conclusions can be drawn.

228 pages. \$2.95. Mic 56-2607

CLIMATES OF THE NORTH ATLANTIC

(Publication No. 18,079)

George Marvel Howe, Ph.D.
Clark University, 1956

Supervisor: Samuel Van Valkenburg

In a general sense, climate has probably always meant "a summary of weather." Its connotation became narrowed to "average weather" by selection and widespread use of the arithmetic mean as the primary statistical parameter of objective regional climatic classification. When expressed as static average weather, climate is not capable of providing answers to many pertinent questions which may be asked about the summary of weather, such as "How often, how many times, and what are the chances of?" The same climate, expressed as "relative frequencies of the weather comprising it," does contain answers to such questions.

Development of climatic regionalization in which climate is statistically represented by frequencies of several weather conditions was the primary objective of this study. The North Atlantic was selected because of access to a large quantity of new data, tabulations and isopleth maps prepared for the U. S. Navy Marine Climatic Atlas of the World, Volume I, North Atlantic, which was predominantly in the form of percentage frequencies. Working with oceanic climate gave the distinct advantage that major similarities of broad climatic regions were probably more easily distinguishable due to less local variability of the underlying surface than might be expected over land areas. The method of regionalization devised is a function of the areal distribution of percentage frequencies of weather conditions within individual months. Climatic regionalization has been prepared for only February and August, respectively the coldest and warmest months and the ones in which shifting climatic zone characteristics attain their maximum southerly and northerly positions.

The initial approach to regionalization is from the "Dynamic Climatology" concept, utilizing the ocean-wide distributions of weather conditions, which exhibit patterns corresponding roughly with major zones of the general circulation. Regionalization was based, however, on what the climate is rather than why it is. After the regionalization was established, the characteristics of the climate were related to daily synoptic weather patterns, a form of "Synoptic Climatology."

Coincidence of centers of maximum and minimum percentage frequencies of light wind, clear sky, precipitation, low cloud ceiling, reduced visibility, and gales indicate fairly well defined cores of zones and regions with climatic homogeneity. In the continuous gradients between the cores are changes in steepness or direction; these seemed the logical separation between climatic regions. Thus,

within a region are not only a homogeneous core but also relative homogeneity in the difference between climatic characteristics of any two places equally distant in a direction normal to the gradient away from the core.

Isotherms of 5% and 95% temperatures in the monthly cumulative frequency distributions, selected to represent the entire distributions, lack the strong zonation characteristics of the other weather elements. Regions with a type of inherent homogeneity, separated by changes in gradient, were found to exist which overlap the zonal pattern. The size of the range between the 5% and 95% temperatures, more than 30°F. in one area, was startling because of its contradiction of the commonly held concept that air temperatures over the ocean are relatively uniform. Analysis of Ocean Weather Ship Station data showed that daily range and variability of air temperature, fairly well correlated with the 5% and 95% range, has much greater magnitude and areal variation than seems to have been suspected.

90 pages. \$1.50. Mic 56-2608

CLIMATE CLASSIFICATION AND THE PRACTICE OF IRRIGATION IN NORWAY

(Publication No. 18,080)

Clara Rom Lougee, Ph.D.
Clark University, 1956

Supervisor: Samuel Van Valkenburg

Irrigation in Norway is in response to moisture deficit, to the need of high yield per unit area of limited arable land, and to decreases in agricultural population which necessitate higher per man production of agricultural crops. Norwegians find that formulae related to climate and agriculture abroad are of little practical value to them in their attempts to relate moisture supply to crop production. Their apparent disregard of well known climate classifications is not generally understood by Americans. It is the purpose of this study to show the reasons for the Norwegian position.

Currently popular classifications of world climate are expressed in formulae derived from temperature and precipitation records. The attempt has been made to evaluate and specify the temperature and rainfall relationships that determine a natural vegetation. In regions which have furnished records for developing world classifications, the climate classifications are said to agree not only with the vegetation zonation but also with development of soil. On the basis of such agreement, it has become common practice to apply the standard climate formulae to any regional study, assuming that they portray the existing relationships between climate and vegetation zones. It has been a next step to describe agricultural regions in terms of world climate classifications.

In the application of Köppen and Thornthwaite classifications to regional analysis of Norway the following conditions are found. There is general agreement between both classifications and general comparison of climate as temperate, cooler, and colder, and humid and less humid, but neither classification is sufficiently refined to single out and predict the dry locations or the foreshadow dry period which is common over the whole country.

Neither classification is in agreement with the pattern of soil development in Norway, but Norwegians believe that soil development in their country is largely acclimatic.

Application to native vegetation zones in Norway proves these classifications to be quite inadequate, and it is concluded (1) that climatic factors other than temperature and precipitation play more dominant roles in Norway than in the locations where the classifications were developed, and (2) that judgments of Norwegian conditions based on these classifications can be of little practical value. It is believed by the writer that the Köppen classification was not intended to be used in regional analysis and that as a comparative description of Norwegian climate on a global basis it may be retained for restricted general use until climate is more adequately classified as a resultant of all climatic factors.

In this study the problem of water supply for agricultural purposes is contrasted with water need for maintenance of natural vegetation. Soil moisture supply by irrigation as a practical matter is being investigated in Norway in its relation to (1) seasonal rainfall, (2) soil composition, variability, and location, and (3) crop needs. These investigations should lead to a more realistic understanding of moisture supply, upon which may be developed a classification of practical use in agriculture.

192 pages. \$2.50. Mic 56-2609

**UNINCORPORATED URBAN SETTLEMENT IN
BUTTE COUNTY, CALIFORNIA:
A CASE STUDY IN URBAN GEOGRAPHY**

(Publication No. 18,083)

Bruce Crossan Ogilvie, Ph.D.
Clark University, 1956

Supervisor: Raymond E. Murphy

The amazing population increase in the urban districts of California in the decade from 1940 to 1950 was unequally distributed; unincorporated areas grew seventy-nine per cent, cities only forty-one per cent. A major deterrent to any research dealing with unincorporated urban areas is the lack of data. Because they do not have specific political boundaries, detailed statistical information on these areas is not available as it is on incorporated places.

This study was instituted to investigate the precise nature of unincorporated urban areas in Butte County, a representative section of Northern California. First, it was necessary to develop a method to differentiate urban from rural districts. The basis for both the delimitation and the analysis was a comprehensive land use inventory which established dwelling ratios and supplied the information for measuring acreage devoted to major classes of land use.

Limits of non-corporate areas were determined on the basis of a density of twenty-five dwellings per quarter section. Relationships among the several land uses were compared and contrasted and the land utilization ratios in unincorporated areas correlated with those in incorporated cities.

Although the extra-municipal settlement in Butte County was not considered typical of unincorporated areas

in all respects, some of the characteristics were deemed to be representative of the development of settlements which have no local government. Non-corporate areas in Butte County were found to be predominantly residential districts, consisting principally of single-family dwellings. Large portions of these unincorporated areas were devoted to streets, roads, and other thoroughfares, but commercial and public uses accounted for lower percentages of land than did the same uses in incorporated cities in the county. The tendency for industrial use areas to develop outside municipal limits in the built-up areas adjacent to cities was as evident in Butte County as it has been in many other places.

Solutions to the problems which have developed because of the unplanned growth of unincorporated urban areas may be effected by: functional consolidation, an administrative coalition of existing agencies; amalgamation of city and county to form a metropolitan county government; incorporation of populous districts; annexation of fringe settlements to the cities they adjoin.

Annexation, where possible, appears to be the superior plan for resolving the problems created by non-corporate urban settlement. Such a political consolidation of the city and its fringe could wipe out overlapping single-purpose special districts, integrate governmental activities under a single control, and provide for effective comprehensive planning by a single authority.

97 pages. \$1.50. Mic 56-2610

**GLACIAL WATER LEVELS IN NARRAGANSETT
BASIN AND THE BLACKSTONE RIVER VALLEY**

(Publication No. 18,085)

Guy Norris Parmenter, Ph.D.
Clark University, 1956

Supervisor: Richard J. Lougee

This study is an investigation of glacial water levels in the Narragansett Basin and the Blackstone River Valley of Rhode Island and Massachusetts. Water levels of bodies of water that existed during the period of deglaciation have been determined through examination of glaciofluvial and static water deposits. Present elevations of the water planes have been measured. Profiles of the water planes demonstrate the nature of postglacial crustal upwarping in the dissertation area.

Static water deposits are found in the lowlands which border Narragansett Bay and extend northward in the lower Blackstone Valley. These deposits are considered to indicate an encroachment of water from the south over the depressed coastal region as the continental ice sheet melted back. The body of water forming the submergence is believed to have been directly connected with the late-glacial sea.

A number of deltas record the single water plane of the submergence. The longitudinal profile of the water plane reveals that there has been considerable upwarping of the earth's crust since the submergence ended. Direction of maximum upwarping as indicated by accordant elevations of the water plane at sites on either side of the Bay, is approximately 35° W of N. At two places the water plane

is deformed by hinge lines. The more southerly of these is in the vicinity of Providence, Rhode Island; the other is near Manville, Rhode Island. The water plane records very large amounts of differential uplift. In the south it is now tilted at a rate of 5.2 feet/mi. At the Providence hinge the rate increases to 8.4 feet/mi; while north of the hinge near Manville the rate is 18.6 feet/mi.

A prolonged halt of the retreating ice margin is recorded in till and outwash deposits in the valley of the Blackstone and its tributaries north of Woonsocket. Halt of the ice margin at this point may have been associated with an uplift of the earth's crust that drained away waters of the submergence. No evidence of the submergence is found farther north.

A glacial lake occupied much of the middle Blackstone Valley. Deltaic deposits and other static water features permit reconstruction of the water plane of this body of water. The tilt rate shown is 10.4 feet/mile.

The upper Blackstone Valley served as a major drainage course for glacial meltwater and was partly filled by a valley train. Terraces of outwash material twenty to forty feet above the present valley floor are remnants of this deposit. The valley train blocked the mouths of tributary valleys giving rise to temporary lakes in several of them. Glacial Lake Quinsigamond was the largest of the tributary valley lakes. At its maximum, this lake merged on the north with better-known Glacial Lake Nashua. The water plane of Glacial Lake Quinsigamond now slopes southeastward at a rate of approximately 9.4 feet/mile.

124 pages. \$1.65. Mic 56-2611

A CONTRIBUTION TO THE GEOMORPHOLOGY OF THE FALSE RIVER AREA, LOUISIANA

(Publication No. 17,452)

Hilgard O'Reilly Sternberg, Ph.D.
Louisiana State University, 1956

Supervisor: Professor Richard J. Russell

False River is an ox-bow severed from the latest course of the Mississippi. It is the lower-most cutoff on the New Orleans channel of the river, the oldest to be completed within historic times, and one of the longest meander loops ever formed by the Mississippi.

The dissertation deals with the processes responsible for the landforms in the False River area, and is based upon field work, the study of aerial photographs, the investigation of historical sources, and, to a lesser degree, the observation of results obtained in laboratory experiments dealing with river models.

There are two distinct stages in the evolution of the area because the processes which prevailed while False River was part of the active Mississippi were quite different from those obtained since the cutoff.

Deformities observed in the old Mississippi channel are related to points of resistance ("clay plugs"), fine-grained fill of old cutoff lakes.

With regard to the unusual length of the False River channel, it is pointed out that a cutoff does not depend so much on the development of the severed loop itself, as on that of adjacent meanders. The concept is advanced that,

whereas overdevelopment of contiguous upstream and downstream loops tends to cut short the growth of an intermediate meander (by precipitating the cutoff), underdevelopment permits the middle loop to acquire unusual length. In retarding the development of the immediate upstream and downstream loops, the Pleistocene terrace bluffs, to the east, played a decisive part in the westward growth of the oversized False River loop.

The actual cutoff, is generally attributed to human interference, viz. to a trench dug across the slender pedicle of the meander loop. The writer attempts to demonstrate, however, that the cutoff was not artificially induced or even accelerated. Evidence is also presented to the effect that, contrary to general belief, the Point Coupée Cutoff was consummated before 1722.

After a meander loop has been severed from the river, deterioration sets in. Two entirely different processes of sedimentation may concur in the filling of the old channel: (1) a considerable portion of bed load may be diverted into one or both ends of the abandoned channel; and (2) suspended load settles out of silt-laden flood waters. Some measure of protection from the invasion of floodwaters was afforded the False River area by the line of artificial levees, which early extended upstream from New Orleans, although over-topping and breaching occurred during every great flood.

Considerable differences in the development of the alluvial fill at the upper and lower extremities of the old channel suggest that diversion of bed load played a considerable role in the filling of the lower end of the horseshoe. Small serpentine streams not only advance these terminal deposits into the open water, but also build up natural levees on the fill, isolating several small areas, giving rise to local lakes or swamps.

Deterioration of the crevasse channels leading out of False River is the result of both natural and artificial causes. Three of the latter, are mentioned by the writer: the construction of dikes and roads across the outlets; accelerated erosion through cultivation; and the introduction of the water hyacinth. The discussion closes with the thought that the post cutoff evolution of False River and contiguous area might have been very different if cultural resources had been applied in another direction.

181 pages. \$2.40. Mic 56-2612

THE AGRICULTURAL SETTLEMENT SUCCESSION IN THE PRAIRIES OF SOUTHWEST LOUISIANA

(Publication No. 17,453)

James William Taylor, Ph.D.
Louisiana State University, 1956

Supervisor: Professor Fred B. Kniffen

This study of agricultural settlement succession in the prairies of southwest Louisiana--4,000 square miles of almost-level land formed as a Pleistocene Delta of the Mississippi River--is directed toward an analysis of the modern landscape and the assignment of its elements to the proper cultural segments.

A broader study of the cultural geography of Louisiana revealed elements and associations in the landscape of the

prairies which contrasted sharply with those in other parts of the state. Data gleaned from family photograph albums, negative files of commercial photographers, and interviews with early settlers were corroborated and augmented by newspaper files and other library materials. These details permitted a theoretical reconstruction of the original landscape produced by each culture segment, thus providing a plane of reference from which to measure cultural change. Hence, the study is organized on the basis of the cultural groups and the landscape is developed through an analysis of changes in form and function of the various cultural elements.

About 1765, Acadian farmers settled on long narrow land-holdings along the eastern prairie streams. Utilizing the better-drained land of the natural levees, their crops and farmsteads formed a linear pattern of settlement along the roads following the levee crests. A small horizontal-log barn behind the mud-daubed dwelling of half-timber construction was enclosed by a pieux fence to form their simple farmsteads.

About 1900 the medium of commercial lumber replaced mud-daub, though the original house form was retained and occurs today with a frequency of forty to fifty per cent. One of two new house types appearing after 1915 occurs with a frequency of forty to sixty per cent. At about the same time three new barn types replaced the older form, and the pieux fence gave way to barbed wire.

In the 1880's grain farmers from Germany and mid-western United States established a secondary cultural nucleus in the western prairies. They converted the grasslands into irrigated rice fields, built large two-story houses and numerous sprawling barns, and developed roads along the section lines. Two smaller one-story house types were introduced about 1915 and a third in the late 1920's as the old types fell from favor. With the mechanization of agriculture and the growth of the beef cattle industry, large barns decreased in number, though four or more barns per farm is still common. The adaptation of the combine to rice added the rice dryer to the towns but reduced the number of rice-straw stacks in the fields.

In the conservatism displayed by the Acadian descendants and the expansion of their small-farm complex into the western prairies lies the cultural uniqueness of the prairies of southwest Louisiana.

217 pages. \$2.85. Mic 56-2613

INTERNATIONAL MAIL FLOWS: A GEOGRAPHIC ANALYSIS RELATING VOLUME OF MAIL TO CERTAIN CHARACTERISTICS OF POSTAL COUNTRIES

(Publication No. 17,148)

Robert Martin Taylor, Ph.D.
University of Washington, 1956

The immediate focus of this study of international mail flows is the relationship between volumes of mail dispatched and certain characteristics of postal countries. In a broader sense the purpose of the study is the examination of factors conditioning flow phenomena.

The pattern, by major area groupings of countries, of the international mail flows (three billion pieces) in 1952

dispatched by 162 Universal Postal Union countries is examined in Chapter Two. The United States alone had one-eighth of the world total of incoming and outgoing mail. The movement between Western European countries and the countries of the Americas was 22 per cent of world movement, that between Western Europe and Africa was 11 per cent. Of the intragroup movements, that of Western European countries (28 per cent of world movement) was the heaviest in volume. A primary focal area of flows is in northwestern Europe, with the United States constituting a secondary focal area. On a per literate basis the African group of countries led the world in number of pieces of international mail sent in 1952 (11.3 pieces), followed by Oceania (7.7 pieces), Western Europe (7.1 pieces), The Americas (3.7 pieces), Asia (1.6 pieces), and Eastern Europe (0.5 pieces). The world average was 3.6 pieces dispatched per literate.

Chapter Three outlines gross associations between characteristics of countries and mail flows. On a per literate basis, the number of pieces of international mail sent is generally higher than average in countries: (1) where the literates form an "elite" minority, (2) that are political dependencies, (3) that have an area of less than 700,000 square kilometers (smaller than Texas), (4) that have non-communist governmental regimes, (5) that have over \$100 per capita value of foreign trade, and (6) have half or more of the value of their exports in the form of manufactured goods. When distance as well as volume are considered, the following characteristics associate with stronger than average mail flows: (1) location far from the primary focal area for mail flow, (2) area between 35,000 and 700,000 square kilometers (larger than Switzerland, but smaller than Texas), (3) migrational (national origin) linkage, (4) political linkage, (5) shared popular or official language, and (6) religious similarity.

A sample of the mail flows of 638 pairs of countries (about two-thirds of world volume of mail dispatched in 1952) is analyzed in Chapter Four. The formulation of the interaction-hypothesis used in this regression analysis is: the logarithm of the per literate pair volume of mail is a linear function of the distance separating postal countries. On arrangement of sample pairs into fourteen distance interval subsamples, it was found that the first three intervals (0-500, 500-1000, 1000-1500 kilometers) had a progressively more negative coefficient of regression of flow with distance. A few of the negative coefficients of regression found on arrangement of subsamples by societal and economic characteristics are: Christian with Christian, -0.45, high value per capita foreign trade (over \$150), -0.53, similar religion, -0.59, similar popular language, -0.65, strong politico-migrational linkage, -0.67, undifferentiated (all 638 pairs), -0.86, different languages, -0.98 weak politico-migrational linkage, -1.07, unlike religions. Coefficients of correlation, size of constant terms, standard errors, and *t* values are given in tables.

Chapter Five summarizes the findings, notes that lack of well developed theory and imperfect knowledge of structural relationships underlying the data were a serious impediment to the study, and recommends further inquiry into the theoretical and empirical aspects of the subject.

161 pages. \$2.15. Mic 56-2614

POPULATION PROBLEMS IN THE GANGES VALLEY

(Publication No. 18,089)

Kripa Nath Varma, Ph.D.
Clark University, 1956

Supervisor: Samuel Van Valkenburg

This study attempts to clarify the demographic problems of the Ganges Valley in India. This Ganges Valley has been rather densely populated throughout its history. Today, planning is being undertaken to raise the standard of living of its people. Essential to this planning is a recognition of the changes now occurring.

It has often been said that the rate of growth of population in the Ganges Valley is high. This study shows that this rate of growth is 1.5% per year. However, in the Ganges Valley, the increase in population has not been balanced by an increase in farm products, though it has been possible to feed the people in the area with surpluses from other parts of the country and from imports. Due to this annual increase in population the production per capita is declining.

As the Ganges population has grown, the land available per capita has declined to 0.6 acres. Farms are small and the farmers suffer from chronic poverty. They use the same type of agricultural tools as they used 50 years ago, and, even now for the most part, depend on cowdung for manures. The farms should not be mechanized unless some new avenues of employment are opened up for millions of farm laborers. The people in general are conservative in outlook and do not like to take chances on new experiments for their livelihood.

The problem of population has been tackled from an inadequate land base. Emigration, birth-control and education have been recommended as the basis for solving some of the congestion.

208 pages. \$2.70. Mic 56-2615

THE RESOURCES OF THE CUMBERLAND PLATEAU
AS EXEMPLIFIED BY CUMBERLAND COUNTY,
TENNESSEE: A GEOGRAPHIC ANALYSIS

(Publication No. 17,171)

George Willis Webb, Ph.D.
The University of Tennessee, 1956

Major Professor: Loyal Durand Jr.

The problem of this dissertation was to make, summarize, and geographically analyze an inventory of the resources of Cumberland County, Tennessee, as a sample section of the flat-topped part of the Cumberland Plateau. The method of procedure used in the study was to draw together the applicable information from the existing reports, and, with the addition of information gathered by field work, summarize and analyze the knowledge about these resources. Data were gathered by library investigation, field observation, and personal interviews.

The major findings and conclusions reached were:

1. Historically, the mining, lumbering, and the wood

industries have been the chief employers of the non-farm laborers of the Cumberland Plateau; the decreased employment opportunities in these industries, and a high birth rate have resulted in constant under-employment and low incomes, for which emigration has been a major solution.

2. Agriculture is still, as it has been historically, generally self-sufficient in character, but some important recent changes were observed: production of vegetables for market leads a trend to a partially commercial agriculture; commercial potato growing has been generally replaced by other vegetables and tobacco; a general fence law put an end to the open-range method of raising cattle, and this has been accompanied by improvement in the breeds of cattle and an increase in hay and pasture crops; the previous trend toward decreasing average size of farm has been reversed.
3. The study of the forest resources revealed a number of important points: forest covers about 86 per cent of the total land area, and is therefore a major resource; as a result of repeated burnings and lack of good management practices in the past, the forests are not producing nearly up to their potential capacity; the county's lumber industry is built chiefly on pine timber, and included in this industry are logging, sawmilling, concentrating, planing, and transporting; with a declining supply of pine timber this industry faces the possibility of a diminution in size or shifting to hardwood of which there is now available an abundant low quality supply.
4. The mechanization of soft coal production has been detrimental to the Cumberland Plateau in several ways: underground mining has been diverted to areas with thicker, more extensive beds; and strip mining, to which the plateau is not well suited, has temporarily replaced the drift method.
5. The quarrying of sandstone has grown into a two-million-dollar business annually, the leading industry in Cumberland County.
6. The ground water supply is not large enough to sustain large industries.
7. The county has a fair system of local roads, and with respect to through transportation there are good highway connections, but the limited railroad facilities will prohibit certain types of manufacturing from locating there.
8. The processing industries have been little developed in the area; in 1950 only 15 per cent of the employed people of Cumberland County were occupied in manufacturing, in spite of the fact that such manufacturing as is found there has been attracted principally by the labor supply; however, the sparse population limits the total labor supply.
9. The plateau's physical environment possesses a number of attributes which have unrealized value as potential recreational resources: summer nighttime temperatures, natural vegetation, wildlife, and topography are advantageous. In view of these natural advantages, the growing demand for outdoor recreation, and the need for the complete development of

all its resources, the county would benefit by diverting more of its energies to this line of endeavor.

The alterations which have occurred in the use of the resources of Cumberland County during the past twenty years suggest that, by developing a program of adjustment to the existing conditions, the people have begun to work out a more economically and socially sound solution to their problems of unemployment and low income than that of emigration. The major lines of adjustment involve a combination of changes in type of farming and improvements in agricultural practices, along with increased part-time employment in non-agricultural enterprises; accompanying these developments are restoration and improvement of the renewable resources.

301 pages. \$3.90. Mic 56-2616

THE INDUSTRIAL GEOGRAPHY OF THE KANAWHA VALLEY

(Publication No. 17,408)

Selva Carter Wiley, Ph.D.
The Ohio State University, 1956

West Virginia's main stream valley cuts directly through the core of a great coal, oil, and gas potential, where industry has been attracted on an ever increasing scale during and after both World Wars. Concurrent with the influx of heavy industries, the demand for more and more raw material has caused some local items to be in short supply. Indeed, several of the better-grade re-

sources which were deemed inexhaustible a few years ago have been depleted or abandoned as inferior. The dynamic changes wrought by exhaustion of resources, industrial research and its inevitable substitutes, and the very press of industry itself have created more problems. However, all of the valley industries do not necessarily have the same problem or group of problems, so that industries are scanned individually.

The natural resources of the valley are discussed in detail as to quantity and quality. When available, data are given for individual plant consumption of these resources, chiefly for coal, oil, and gas. Products and processes of each industry and, in many cases, individual plants have been covered on a non-technical basis.

Manufacturing questionnaires were submitted to all major industrial concerns of the valley. Most of this was accomplished from 1950 through 1955. Often the questionnaire was completed during personal interviews but, on occasion, the parent office located outside Kanawha Valley had to be consulted. Ground-level photographs were made by the writer in the course of field work and personal interviews. A considerable amount of library work gives a background for settlement and industrial patterns.

Results were generally satisfactory, although a shroud of secrecy seems to prevail in certain chemical industries where there was either direct refusal or obvious reluctance to answer questions. Most people, however, cooperated in the research and aided in bringing it to fruition.

Despite crowding, exhaustion of raw material, and competition from other industrial areas, the vested interests of Kanawha Valley industry will keep it functioning normally for many years to come.

346 pages. \$4.45. Mic 56-2617

GEOLOGY

THE MICROPALAEONTOLOGY OF THE OLDSMAR LIMESTONE OF FLORIDA

(Publication No. 17,192)

Harold Leonard Levin, Ph.D.
Washington University, 1956

Chairman: Dorothy Jung Echols

The study is concerned with the determination of the quantitative and qualitative micropaleontology of the Oldsmar limestone. Biostratigraphic zones are disclosed by use of counts of fossils as they occurred in the well cuttings. By comparison of lithologic and paleontologic data with similar studies of Recent sediments, the ancient environment of deposition is suggested. The fauna is fully described and illustrated. It includes 24 species and 3 varieties of Foraminifera, and four species of Ostracoda.

Standard procedures for disaggregation of rock samples and preparation of thin sections were used. In addition, the use and limitations of radiography in studying the larger species is discussed.

A composite chart, suitable for commercial use, is

prepared and suggested as an excellent device for presenting large quantities of data in a simple manner. The use of such charts is indicated as useful in petroleum exploration.

91 pages. \$1.50. Mic 56-2618

PEBBLE PHOSPHATE OF ALACHUA COUNTY, FLORIDA

(Publication No. 17,534)

E. C. Pirkle, Jr., Ph.D.
University of Cincinnati, 1956

The pebble phosphate concentrations at the top of the Hawthorne formation in the plateau area of Alachua County, Florida were studied as to mode of accumulation and economic possibilities. The Hawthorne formation was evaluated as a possible source for "hard-rock" and "soft-rock" phosphate now found in the Alachua formation. The solution of these problems required a study of the physiographic development and post-Eocene stratigraphy of this region.

The solution-pitted surface of the Ocala limestone suggests subjection to sub-aerial weathering and erosion before the deposition of all later beds except possibly the Suwannee limestone. During the Oligocene a large part, if not all, of western Alachua County was beneath the sea, and the Suwannee limestone accumulated as is evidenced by scattered residual boulders of that limestone. In the Lower Miocene at least part of Alachua County was land, for remains of land vertebrates of that age have been found in the county. During this terrestrial interval most of the Suwannee limestone probably was eroded from western Alachua County.

With the advance of the Middle Miocene sea, Hawthorne sediments were laid down over all the county. In parts of northeastern Alachua County marine sediments of Chocataw hatchee age, late Middle Miocene and/or Upper Miocene, were deposited. During much of Pliocene time the area again was above sea level, as indicated by the many land vertebrate fossils of Pliocene age known from the county.

During the Pleistocene the area was inundated from time to time by the sea. The "thick" sands north of Gainesville, the red and yellow clayey sands and sandy clays of northeastern Alachua County, and the orange-tan clayey sands south of Gainesville and in parts of southwestern and western Alachua County are believed to represent marine Pleistocene deposits. Land vertebrate fossils of Pleistocene age are present in sediments filling solution cavities in the Ocala limestone south of Gainesville and throughout western Alachua County.

The Hawthorne formation as herein considered consists of two different types of sediments. The main body of the formation is marine and of Middle Miocene age. At its top is a concentration of pebbles and grains of phosphate mixed with varying portions of sand, clay and carbonate. The primary accumulations of this pebble phosphate are believed to have formed under marine conditions during the Miocene. In some places the original marine deposits were subsequently modified or reworked by weathering, rainwash and streams. These materials add to the low grade phosphate reserves of the State of Florida a minimum of between 30 and 50 million tons of phosphate particles which average at least 50 percent Bone Phosphate of Lime (BPL).

The Alachua formation in Alachua County is restricted to the plains area and the more highly dissected portions of the plateau. It consists largely of the residual detritus of weathered and eroded post-Eocene strata often mixed with boulders of Ocala limestone. Some of this material was formed in situ, whereas other parts represent material carried by streams and rainwash into joints, sink holes, shallow lakes and other low places in the Ocala limestone. Such materials, terrestrial in origin, range widely in age. The phosphate found in the Alachua is most probably derived from the Hawthorne formation.

The phosphate particles found in the Hawthorne formation are of different origins. The dominant types include concretionary oolites and masses, aggregated masses, steinkerns, replacement of skeletal remains, replacement of carbonate in fragments of shell marls and limestones and phosphatic clay balls. These pebbles and grains reflect various environments under which the particles formed. The dominant types of phosphate particles in a deposit appear to be a factor in "high-grade" as compared to "low-grade" properties.

224 pages. \$2.90. Mic 56-2619

CRETACEOUS OSTRACODA FROM THE PERSIAN GULF AREA

(Publication No. 17,487)

Abdullah Shakir Sayyab, Ph.D.
State University of Iowa, 1956

Chairman: Associate Professor William M. Furnish

Forty-four species of Upper and Middle Cretaceous ostracodes are described from nine wells in oil fields of the Persian Gulf area; forty-one are new. Twenty species are described from the Upper Cretaceous; fifteen of these belong to the well known genera: *Cytherella*, *Cypris*?, *Bairdoppilata*, *Bythocypris*, *Xestoleberis*, *Cytheropteron*, *Haplocytheridea*, *Brachocythere* and *Cythereis*?. The other five species are classified under new generic names: *Mesocythereis*, *Anchocythereis* and *Eobuntonia*. Twenty-four species were recovered from the Middle Cretaceous, twenty-one of which are new. The genera *Cytherella*, *Cytherelloidea*, *Paracypris*, *Bairdoppilata*, *Bythocypris*, *Krithe*, *Hutsonia*?, *Cythereopteron*, *Macrodentina*, *Cli-throcytheridea*, *Monoceratina* and *Cythereis* account for seventeen species; and representatives of the newly proposed genera *Eocytherura*, *Anchocythereis*, *Amphicythereis* and *Amphidentina* make up the additional seven species.

Subdivisions of the Middle Cretaceous may be correlated by an upper *Cythereis arabica* zone and a lower *Amphicythereis bahreinensis* zone. Assignment of the Middle Cretaceous section to the Albian-Cenomanian is suggested on the basis of faunal evolution.

The lower portion of the Upper Cretaceous was included in this faunal study for comparison. The age of the containing beds probably varies in the different wells, but a few species appear to range throughout the section sampled.

155 pages. \$2.05. Mic 56-2620

HEALTH SCIENCES, PHARMACY

A STUDY OF SOME BUTYL AND ISOPROPYL
ESTERS IN THIXOTROPIC SYSTEMS

(Publication No. 17,547)

Barry Harold Dashowitz, Ph.D.
The University of Florida, 1956

The gelling action of various concentrations of aluminum soaps and bleached beeswax has been studied in two homologous series of fatty acid esters. The esters employed were butyl and isopropyl myristate, palmitate and stearate. The effect of temperature, prolonged heating and method of cooling was found to influence the viscosity and the thixotropy as well as the stability of these systems. In addition, the effect of added substances such as organic acids and alcohols on apparent viscosity and thixotropic behavior were noted.

Twenty per cent beeswax-ester mixtures, when heated to 170 - 175° C. for five minutes and cooled rapidly in an ice bath, formed highly viscous dispersions which lost their thixotropic behavior on prolonged storage. Ten, twelve and fifteen per cent wax-ester dispersions prepared in a similar manner possessed lower apparent viscosities but retained thixotropy over longer periods of time. Slowly cooled wax-esters dispersions did not form thixotropes which were as viscous nor as stable as rapidly cooled mixtures.

Aluminum monostearate, in low concentrations, was found to impart high viscosity dispersions to each of the butyl and isopropyl esters. Three per cent formed a pliable gel which was easily reverted to a more liquid state upon agitation. Most of the samples showed the highest viscosity when heated to 120 - 125° C., and lowest viscosity was noted when the samples were prepared at the 170 - 175° C. temperature range. Heating the dispersions to the higher temperature caused a sharp increase in viscosity within the first fifteen days. Prolonged heating at any of the temperatures usually lowered viscosity and produced an appreciable decrease in thixotropy but tended to stabilize the preparation. Generally, slowly cooled gels had uniformly higher viscosities than rapidly cooled samples. A single-stage hand homogenizer was used to remove any lumps of gel that may have formed during the gelation process. Homogenization was also found to increase viscosity and stabilize the finished gel in a shorter time period.

Aluminum laurate dispersions formed the weakest gel structure of all the aluminum soaps studied. Aluminum distearate gave a heavier gel than the aluminum tristearate or aluminum monostearate in the same vehicle under identical conditions. Aluminum palmitate formed a strong gel intermediate between that of the aluminum mono- and distearates.

The viscosity and thixotropy of various combinations of soap-wax-ester systems were found to be dependent on the soap and wax ratios. Ten per cent wax in one and two

per cent aluminum monostearate gels produced optimum stability.

The effects of suspending insoluble powders in the thixotropic vehicles ascertained the adaptability of these dispersions for use as parenteral repositories. The ten per cent wax-ester dispersion was found to be optimum; it remained fluid enough upon agitation to flow freely yet possessed sufficient body to prevent flocculation of the suspended particles.

The anomalous behavior of these non-Newtonian systems were studied using a Brookfield viscometer. The determination of thixotropy in this investigation was a relationship of the difference between two arbitrary coefficients- thixotropic index and equilibrium index. The thixotropic index was obtained by dividing the apparent viscosity, on the breakdown-curve, at the lowest rate of shear by the apparent viscosity at the highest rate of shear. The equilibrium index was similarly obtained using the same points on the buildup-curve. This procedure was found to be reliable in reproducing results and in giving data which was easily interpreted.

123 pages. \$1.65. Mic 56-2621

LIPOGENESIS IN SUBMERGED GROWN CLAVICEPS
PURPUREA AND INVESTIGATION OF THE
UNSAPONIFIABLE MATTER

(Publication No. 18,321)

James Elwood Dusenberry, Ph.D.
The University of Connecticut, 1956

The purpose of this study was to more fully understand the metabolism of *Claviceps purpurea* (Fries) Tulasne, by observing the relationship of time and variation in media to lipid formation in submerged culture.

The culture of ergot used in these experiments had been obtained from mature sclerotia under aseptic conditions and maintained on nutrient agar slants. Inoculum for submerged growth was made by transfers from these slants to nutrient solutions in flasks. After a period of incubation in a constant temperature room aliquots were taken to inoculate the media in the three different types of fermentation vessels used in the study. Comparative fermentations were conducted in a modified Pfaudler Reactor, twelve-liter wide-mouth carboys, and 500-ml. Erlenmeyer flasks. A simple, two-salt, basic inorganic nutrient solution was used. Except for changes in the amount of the two carbon sources used (dextrose and mannitol) the nutrient media was quite similar in each study.

After varied periods of incubation, the growth tissue was separated from the culture media by filtration, washed with distilled water, and dried in a Stokes freeze-dryer. The tissue was prepared for extraction by breaking the mycelial clumps in a Waring Blendor and comminuting in

a ball mill. The lipid material was extracted quantitatively from the powdered tissue with petroleum ether.

The data indicated that the type of reaction vessel together with the carbon source limited growth weight and formation of lipid material. In the carboys, more growth weight per unit volume and a higher percentage of lipid material was obtained with dextrose. In the Pfaudler Reactor, mannitol produced the higher growth weight, but dextrose remained the better carbon source for lipid formation. Most of the data showed the yields of lipid material to be inversely proportional to growth weight.

A gradual increase in the initial concentration of carbon, from 2% to 8%, showed a gradual increase in lipid formation for both dextrose and mannitol. Among various concentrations of organic nitrogen, a 1% concentration of casein hydrolysate as the nitrogen source, produced the maximum yield of mycelium, and also showed the highest yield of lipid materials.

The addition of zinc to the media in the Pfaudler Reactor produced a more striking increase in lipid content with mannitol as the carbon source than with dextrose. In the carboys, the lipid synthesis was stimulated with dextrose as the carbon source. Certain additives produced a variety of effects on the lipid formation. Histamine Dihydrochloride and Calcium Pantothenate showed some stimulatory effect on lipid formation. With diethylamino-1,2,3,4-tetrahydro-6-carbazolyl carboxylate a lipid content of 11% was found, but the growth weight was radically reduced. Supplementary ergot oil was utilized without having an apparent affect on lipid formation, although growth weight was slightly increased.

The lipid content of the organism grown on surface culture was approximately the same with or without the addition of zinc to the media, but the growth weight was less with the metal present.

The lipid material was saponified, and the unsaponifiable matter amounted to 8.76% of the oil. The sterol portion, isolated via the digitonide, was found to be principally ergosterol. A paraffin hydrocarbon (m.p. 58° - 60° C., $n_D^{20} = 1.6874$) constituting a high proportion of the nonsaponifiable matter, was isolated. Its constants did not coincide with those of any hydrocarbon reported in the literature.

56 pages. \$1.50. Mic 56-2622

A STUDY OF DISPERSION WITH ULTRASOUND

(Publication No. 18,332)

Bernard Misek, Ph.D.

The University of Connecticut, 1956

The suitability of utilizing ultrasound for the preparation of pharmaceutical suspensions was investigated employing progesterone as the material studied. A turbidimetric method was devised to determine the efficiency of the ultrasound in reducing the particle size of the suspended progesterone. It was shown that suspensions can be prepared in which 85% of the suspended progesterone is present as particles of 10 microns or less in size.

The concentration of the material being exposed to the ultrasound was shown to have no effect upon the resulting particle size. After a standard ultrasonic exposure, the smaller the initial size of the particles the smaller will be the resulting size of the particles. However, regardless of the initial size of the particles, the same particle size can be obtained by prolonging the period of insonation of the suspension containing the larger particles. The addition of a surface-active material to the suspending liquid facilitated the dispersion of the progesterone by the ultrasound. At a constant ultrasonic intensity, the particle size of the progesterone increased as the viscosity of the suspending medium increased. Various steroids were shown to differ in their ease of dispersion.

The effect of the temperature of the suspending liquid upon dispersion was studied. At the lower levels the temperature of the liquid had no effect. However, near the boiling point there was a considerable decrease in the extent of dispersion produced by ultrasound. The application of a 15 lb. pressure upon the suspending liquid was shown to render dispersion most efficient. Pressures above and below this optimum caused dispersion to be less efficient.

An increase in dispersion occurred when the distance between the under surface of the exposure chamber and the upper surface of the oscillating crystal was a whole number of half wavelengths. At the levels studied, the frequency of the ultrasonic vibrations had no effect upon the dispersion of the progesterone. Maximum dispersion was attained by insonation for a period of 15 to 20 minutes when 200 mesh progesterone was used. The use of progesterone of a larger initial particle size increased the time required to produce maximum dispersion. Once maximum dispersion was attained insonation for longer periods of time produced no measurable effect. Dispersion of the progesterone was increased as the ultrasonic intensity was increased.

Stability studies of progesterone suspensions indicated that there was partial agglomeration of the particles after four weeks' storage at 45°C. The use of up to 0.9% sodium chloride did not appreciably affect the agglomeration of the progesterone particles. Protective colloids alone or in combination with 0.9% sodium chloride did not aid in preventing the growth in size of the suspended particles.

85 pages. \$1.50. Mic 56-2623

HISTORY

HISTORY, ARCHAEOLOGY

MIDDLE HELLADIC MATTPAINTED POTTERY

(Publication No. 17,529)

Robert John Buck, Ph.D.
University of Cincinnati, 1956

The Bronze Age in the Aegean area has been studied according to the following geographical divisions: Minoan (for Crete), Cycladic (for the Cyclades) and Helladic (for the Mainland). Each of these has been further subdivided into Early, Middle, and Late periods. The several divisions and subdivisions are made largely on the observation of changes in pottery, as revealed in the stratified layers of settlement debris. At the beginning of the Middle Helladic period (ca. 1850 B.C. to 1550 B.C.) new styles of pottery replace the Early Helladic material, and at many sites an ash layer separates the Early and Middle Helladic strata. The corresponding Middle Minoan and Middle Cycladic periods, on the other hand, show ceramic evidence of gradual evolution from their respective Early phases. One of the new Middle Helladic wares is Mattpainted pottery. This term is used to mean a ware decorated in a mat, i.e., a flat, dull paint, with a common repertory of shapes, motifs and fabrics.

Many theories have been put forward about its origins. Equally divergent opinions are held concerning its course of development, the relative strength of the influences upon it from Northern Greece, the Cyclades and Crete, and concerning its influence on Late Helladic pottery.

The ware has been found at seventy-two sites on the Mainland; at eighteen of these, stratigraphic evidence is available. A similar Mattpainted ware appears in the Cyclades. In this study each Middle Helladic Mattpainted piece (except for insignificant fragments) has been catalogued according to its shape and decoration. The stratification of the Middle Helladic sites has been compared to determine which shapes and decorations are early and which are late. At some sites an ash layer does not separate the early Helladic from the Middle Helladic layers. At these, and at several where the layer occurs, Minyan pottery, another characteristic Middle Helladic ware, occurs earlier than Mattpainted. Minyan Ware appears at Troy and in Macedonia unassociated with Mattpainted pottery. Hence no cultural association existed between Minyan and Mattpainted Wares until after the beginning of the Middle Helladic period. The development of wares is shown to be reasonably uniform throughout the Middle Helladic area.

The shapes, decorative styles and motifs which are demonstrably early have their best parallels in Early Cycladic pottery. Two-thirds of the motifs have not even been found in Early Helladic. The technique of mat painting is all but unknown in Early Helladic, but is very common in Early Cycladic, and was developed there. Middle Helladic Mattpainted pottery seems to have originated in the Cyclades.

Most of the Mattpainted pottery from the later stages of the period clearly evolves from earlier MH material. The

shapes reveal a fusion of Mattpainted and Minyan traditions. The decoration, though largely of Middle Helladic development, shows some admixture of Cycladic motifs, indicating a continuation of relations with the Islands. One local variety has hints of Macedonian influence. In the latest part of the period a strengthening of Cycladic intercourse is evidenced by the adoption of several shapes and of polychrome decoration. Not until the transition to Late Helladic do unequivocal signs of Cretan influence appear. Soon after the entry of Minoan fashions Mattpainted pottery ceases to be produced. By Late Helladic II it had disappeared, but the Middle Helladic shapes and Middle Helladic preference for restraint and order in decoration survived to exert influence on Late Helladic III ceramics.

Little direct Minoan influence is observable on Middle Helladic Greece, and virtually no Middle Helladic material has been uncovered at Cnossos. Since both Minoan and Helladic wares are common in the Cyclades it may be inferred that the Islands were in some way intermediaries between Greece and Crete. Since the Greeks controlled the Near East trade by Late Helladic I, a possible explanation of the strengthening of Cycladic influence in late Middle Helladic and of the Minoan influx in Late Helladic might be Greek expansion into the Aegean.

In summary, Mattpainted pottery was a Cycladic contribution to Middle Helladic culture; it developed for 300 years by a fusion with Minyan Ware. There are hints of contact with Macedonia, and clear signs of Cycladic influence in the closing phases of the period. The technique passed out of use with the introduction of glazed wares and Cretan designs. 200 pages. \$2.60. Mic 56-2624

THE ARCHEOLOGY OF WAKEMAP: A STRATIFIED SITE NEAR THE DALLES OF THE COLUMBIA

(Publication No. 17,119)

Warren Wendell Caldwell, Ph.D.
University of Washington, 1956

The current literature of Plateau archeology is couched largely in terms of typology; there is neither an extended sequence of cultural change nor any total synthesis of local data. The purpose of this study is to demonstrate such a stratigraphic sequence, based upon a large, localized, group of materials from Wakemap, and to relate it to the other reported sites in the Northwest.

Wakemap Mound is a deep, stratified site, first occupied before 2,000 B.P. and evidencing a continuity terminated only shortly before European contact. Four cultural horizons are present; a basic, generalized hunting, fishing, gathering emphasis transcends into a developed Plateau economy.

Intensity of occupation increases progressively until the late prehistoric period. The material pattern of the latter is substantially that of the ethnographic Wishram.

Comparative data indicate close ties with the McNary Reservoir to the east and with the Yakima-Priest Rapids and the upper Mid-Columbia to the north. There is an evident but lesser degree of similarity to the Upper Columbia and the sites of the northern Plateau. It is also apparent that at an early time, the Plateau, the Great Basin, and the southern Northwest Coast were closely related in subsistence orientation and material culture. The pattern in all three areas is probably derived from a common base.

The following Plateau-wide generalizations are offered:

- A. Cultural development was progressive and cumulative.
- B. There was a trend toward uniformity in material culture, particularly in the middle and late periods.
- C. Varying external influences and internal emphasis have produced cohesive, sub-regional cultural units: 1. The Lower and Mid-Columbia, 2. The Thompson-Okanagon Valleys of British Columbia, 3. The Upper Columbia (transitional between 1 and 2).

471 pages. \$6.00. Mic 56-2625

HISTORY, MODERN

THE SURVIVAL OF THE CHURCH OF ENGLAND AS BY LAW ESTABLISHED - 1828-1860

(Publication No. 17,042)

Olive J. Brose, Ph.D.
Columbia University, 1956

The repeal of the Test and Corporation Acts in 1828 and Roman Catholic emancipation in 1829 signified a change in the relationship between Church and State which necessitated a reappraisal of what constituted an Established Church. By accepting in pragmatic fashion the actualities of the Church's new position and rejecting all theories about the relationship between Church and State, churchmen formulated two fundamental criteria for an Establishment -- the inalienable nature of Church property and the necessity for the Church to perform its function in society as an instructress of the people.

These criteria were under attack in the critical period of parliamentary reform in the 1830's. The inefficiencies, inequalities, sinecures and privileges of the Church which paralleled those in the State were handy weapons for Benthamite Radicals, those most effective spokesmen for the dominant utilitarianism of the insurgent middle classes. By discovering that Church property was not private but public, and that the Church's function as educator might better be transferred to the State as the dislocations of industrialization grew greater, Radicals effectively challenged the basis on which the Establishment rested.

The response to these challenges by the Establishment after 1832 was made in similar terms. Proof of the Church's utility was to be found in that efficiency of administration exemplified by the Ecclesiastical Commission, and by social adaptation through Church education as the answer for all social ills. As creators and shapers of this defense, Sir Robert Peel and the Bishop of London (Charles James Blomfield) made possible the continuation of the link between Church and State.

In the first reformed Parliament of 1833 the Irish tithe crisis forced Church defenders to concentrate on the negative aspect of that defense -- Church property. The successful stand taken by Peel against appropriation of Church revenues by the State was to remain consistent in all similar attempts whether in Ireland or in the English Church Rates Bill of 1837. By skillful political strategy Peel prevented a complete Whig capitulation to Radical pressure and so insured that redistribution rather than appropriation would be the guide in all Church reform.

The Irish Church Temporalities Act provided another precedent for English Church reform by establishing the Irish Ecclesiastical Commission in 1833, three years before its English counterpart. Reflecting the whole emphasis of the age on central bodies in administrative reform, the English Ecclesiastical Commission was the focal point for redistribution of Church property and changes in Church land tenure. Bishop Blomfield used his tremendous energy to fight for the function of the Commission, both at its establishment in 1836 and at every stage of its growth, as enabling the financial resources of the Church to be utilized for that social adaptation exemplified by church extension and education. In the 1850's when other central bodies like the Board of Health were under attack, the Commission's powers actually increased and have remained a permanent part of the Church-State structure to this day.

The whole struggle over religious versus secular state education provided the Church with its most serious challenge as it endeavored to prove its utility in the social sphere by championing religious rather than secular education as a guarantee for the State of a quiet, orderly, industrious population. This question of the education of the people revealed the ambiguity inherent in the continued recognition of the Church by law established, for the Church of the nation was rejected as the nation's sole educator.

396 pages. \$5.05. Mic 56-2626

WILLIAM PITT FESSENDEN, STATESMAN OF THE MIDDLE GROUND

(Publication No. 17,614)

Charles Albert Jellison, Jr., Ph.D.
University of Virginia, 1956

Among the national statesmen of the middle years of the past century, few played a more significant role than William Pitt Fessenden of Maine. Entering the United States Senate in February of 1854 during the convulsive Kansas-Nebraska debate, he almost at once rose to a place of leadership among that small band of anti-Nebraska Congressmen who soon after swung their support to the infant Republican party. From that time until his death in 1869 Senator Fessenden occupied a commanding position in national councils, where his powerful intellect, his mastery in debate, and his unquestioned integrity caused him to be considered by many of his colleagues as the foremost legislator of his day.

Despite the high standing he claimed among his contemporaries, however, Fessenden has been relegated by time to an undeserved obscurity. Even the most dedicated historians of the Civil War period have tended to give him only meagre attention, with the result that no satisfactory account of Fessenden's life and political activities has ever been prepared, save for a valuable but in many respects inadequate biography of the Senator written by his son some fifty years ago. It is the purpose of this dissertation, then, to assuage this lack and to sketch within the limits of restricted space and time the outlines of the private and public life of Fessenden of Maine. To accomplish this, primary reliance has been placed upon manuscript materials, most especially upon the Senator's private papers, which have hitherto remained inaccessible to historians.

The story of Fessenden is the story of integrity and ability in politics. Reared and educated in a strongly Federalist and puritanical environment, he entered at an early age the arena of state politics where he experienced a rapid rise to a position of prominence among the Maine Whigs. For a time, 1841-1843, he sat in Congress as a devoted supporter of Henry Clay's American System, but not until 1854 did he emerge upon the national scene to take the Senate seat he was to hold for fifteen critical years.

During the turbulent years of the middle and late 1850's Fessenden figured as a leading spokesman in the Senate for the new Republican party against Southern demands for slavery extension; and throughout the long war that followed he labored tirelessly and with great effect, both as Senator and briefly as Secretary of the Treasury, for complete and final victory over the Confederacy. Once this victory had been won, Fessenden was named by his colleagues to head the all-important Joint Committee on Reconstruction; and consequently he wielded great influence in initiating the Congressional program for restoring the Southern States.

With the ascendancy of Radical Republicanism after the summer of 1866, however, Fessenden came to assume a role of greatly diminished importance. Inclined towards political conservatism, he held little sympathy for the Radical program, and by early 1867 Senator Fessenden often found himself in open opposition to the majority of his party. As a result he was frequently berated as an obstructionist by the more extreme of his colleagues. But for Fessenden there were stronger considerations than party fealty, and he consistently refused to be bullied out of his beliefs. When in the spring of 1868 he was called upon to make a momentous choice between party and personal convictions, he chose the latter and cast his vote for the acquittal of Andrew Johnson.

In the late summer of 1869, little more than a year after the impeachment trial and at a time when public sentiment was rapidly growing aware of the wisdom and courage of his acquittal vote, William Pitt Fessenden of Maine died at his home in Portland. For the Senate and the nation the loss was a severe one, for with Fessenden there passed from the national political scene a large measure of that honest conservative statesmanship and personal integrity with which the legislative halls of the period were far too scantily blessed.

483 pages. \$6.15. Mic 56-2627

THE UNSETTLED MR. COTTON

(Publication No. 18,187)

Harry Alexander Poole, Ph.D.
University of Illinois, 1956

This is a study of the theology of John Cotton, a divine who arrived in New England in 1633. He soon became involved in the Antinomian dispute, and his somewhat discreditable behavior brought upon him considerable opprobrium from English opponents of the Congregational Way. Despite Cotton's weak defence of his vacillating role in the Antinomian Trials, he went on to become one of the leading publicists for the New England Congregationalists during the English Civil Wars.

Seeking an explanation for Cotton's behavior I delved deeply into the theological writings of this divine. In addition I travelled to England where I searched in the British Museum, the Public Record Office, the library of Lambeth Palace, the Lincolnshire Archives Office, the archives of the Town Hall in Boston, Lincolnshire, and in the library of St. Botolph's Church, Cotton's old parish in England. In addition, I examined manuscripts in Emmanuel College Library, Cambridge. In some of these places I found a wealth of material relating to John Cotton and the New England scene. In all I found something of interest.

I found Mr. Cotton to have been a seeker after divine truth in the Humanist tradition, a man who examined closely the Scriptures and the earliest commentaries on them. This searching led him into various theological positions, some of which were politically undesirable. Both in New and in Old England, his profession of unpopular opinions brought him into conflict with the authorities. In both areas of the World, he recanted his opinions in favor of more orthodox ones when the authorities brought pressure upon him. In the latter case it was the Antinomians who suffered because of Cotton's abandonment of his religious theories. They had followed Cotton as their spiritual guide. To them he was a virtual Paraclete. Their misplaced faith made their fall the more painful. Indeed, Cotton not only abandoned them, but turned against them actively at the trial.

In England, Cotton's recantation seems to have brought no painful readjustments for members of his congregation. Instead, peace and harmony, brought through a return to ecclesiastical orthodoxy, was maintained in Boston, Lincolnshire, until shortly before Cotton's departure to the New World in 1633.

Finally, this thesis attempts to show Cotton's theological position viz-a-viz the Covenant Theology preached by the seventeenth-century non-conformists in both Englands. It demonstrates that there was amongst the Congregationalists, both of England and New England, a great deal of diversity of belief concerning the Covenant and its correlaries. Indeed, these divines seemed to know what they were against, rather than what they were for.

377 pages. \$4.85. Mic 56-2628

AMERICAN VIEWS OF INDIA AND INDIANS,
1857-1900

(Publication No. 17,280)

Bernard Saul Stern, Ph.D.
University of Pennsylvania, 1956

Supervisor: Holden Furber

The purpose of this study is to describe concepts held by Americans about the Indian sub-continent and its peoples between 1857 and 1900. The author consulted a wide range of literature, selecting at random from travelbooks, memoirs, United States Government documents, and periodicals, those comments which he considered especially significant and illustrative of the opinions expressed about India and its society. The topics studied were American views of the Mutiny, Indo-British social and political relations, philosophy and religion, education, the arts and amusements, customs, and economic life.

A thorough examination of the voluminous consular reports for the period disclosed that they were concentrated on economic matters and replies to inquiries regarding trade possibilities in India. Occasionally, consular officials included in their dispatches comments about the land and the people, but these insertions were rare. More rewarding were the writings of missionaries which attempted to describe Indian life in all its aspects. Since these sources were numerous and their details repetitious, the author used considerable discrimination in choosing his material.

Another fruitful source was the published observations of travelers--statesmen and generals, women on special tours in the interests of Sunday School groups and reform societies, and lecturers gathering data for their platforms in America. Discretion was likewise exercised in selecting this material, in order to present views with a semblance of balance because American biases about India, whether pro or con, ran to such extremes.

Other scattered sources included comments from newspapers and periodicals on events in India and Indian personalities, extracts from letters, and reports to the United States Congress on subjects like taxation in India, irrigation, education, and agriculture.

The results of this investigation have shown that the Mutiny of 1857 signalized the beginning of an era of greater American awareness of India because the conflict directly threatened the lives of American missionaries and posed a question as to the survival of American missionary establishments which had been operating in India since the first decade of the century. Also, the Mutiny represented a serious threat to the stability of the British position in Asia, a matter of concern to many influential circles in the United States. This new awareness of India, hitherto an unknown land to most Americans, was marked by an increase in Indic scholarship. Churches accelerated their support of missionaries in the field. Popular weeklies and other periodicals carried large numbers of articles devoted to the life of India.

A thorough search of the sources to determine if there were definitive changes in American concepts during the half century period, has been only relatively successful. For example, the distaste of missionaries for Indian society evinced in earlier writings seemed to have abated as the activities of this particular group shifted from evan-

gelism and proselytizing to education and social services. Expressions of humanitarian concern over the welfare of the Indian people were dominant throughout all American works on India as the century neared its completion.

Gaps of information, faulty interpretation, and a general lack of insight into the problems of India were all-pervasive in the writings on India. Generally, the more sensational aspects of Indian life and especially the ritualistic facets of religion, were described, thus reinforcing ancient stereotypes about the fantastic, mysterious Orient.

Yet, the importance of this American literature on India in the period lies in the fact that it captured the attention of hundreds of thousands of ordinary Americans. Notwithstanding the incompleteness or faultiness of concepts so acquired in American minds, these constituted the first introduction of India to large numbers of Americans.

291 pages. \$3.75. Mic 56-2629

PROPORTIONAL REPRESENTATION IN THE
SOCIAL AND POLITICAL CONFLICT
IN GERMANY, 1871-1920

(Publication No. 17,373)

Donald Jenks Ziegler, Ph.D.
The University of Nebraska, 1956

Adviser: Robert Lewis Koehl

Conflict and change dominated the history of the Second Reich. Industrialization had undermined the economic position of the agrarian forces which dominated German society and politics. Industrialization had increased the numbers and importance of the middle classes, and had fostered a mass of urban workers led principally by the socialists. Conflicts followed between the representatives of agriculture and industry, between the champions of authoritarian government and the advocates of freedom and democracy, between those who upheld the established order and those who wished to tear it down.

Participants in the struggle sought in suffrage reform an instrument for the preservation or extension of power, a weapon with which to quell their opponents. They found in proportional representation an electoral technique most adaptable to such ends in a society of change and diversity. As a system of election designed to accord expression to all shades of opinion among the voters, proportional representation was hailed by its proponents as the most just, the most democratic in existence. As employed in Germany, however, the system became principally a weapon directed against socialist majorities. Political parties representing middle class and agrarian groups in municipal councils, state legislatures, and the Reichstag extended the system to urban districts where voting strengths of socialists were concentrated. To undermine the latter's domination of the workers' movement in Germany, Reichstag parties introduced proportional representation for elections to the numerous boards and other bodies which had arisen with social and factory legislation.

The paradox of proportional representation in the social and political conflict in Germany was heightened by the incomprehension of democratic government revealed in the

attitudes of those who expressed themselves on the system. Political parties were viewed, not as means for directing public policy and assessing responsibility, but as ends in themselves, as groups of like-minded individuals dedicated to the preservation of particular *Weltanschauungen*. Representation became an ideal of reflecting minority opinions among the voters in the elected parliament, an ideal ex-

pressed *ad absurdum* in 1920 in the electoral law of the Weimar Republic. The attitudes suggest that the Germans not only failed to practice democracy in their social relations, but also had no real comprehension of the functioning of democratic government and were little prepared for the Republic which they acquired in 1918-1919.

248 pages. \$3.20. Mic 56-2630

HOME ECONOMICS

EFFECT OF GRANULE SIZE, CITRIC ACID
AND SUCROSE ON PROPERTIES OF PASTES
AND GELS OF WHEAT STARCH

(Publication No. 18,270)

Ada Marie Campbell, Ph.D.
Cornell University, 1956

Chairman: Professor Alice M. Briant

The purpose of the investigation was to study the effects of granule size, citric acid and sucrose on the pastes and gels of wheat starch in a factorial experiment. Four granule-size distributions of each of four wheat starches were heated with four concentrations of citric acid and four concentrations of sucrose. Pastes were heated to 93° C. in a Brabender amylograph and held at that temperature for 15 minutes. Measurement of gel strength was made after 24 to 26 hours' storage at approximately 30° C. Iodine uptake by the material in solution was estimated colorimetrically for 108 of the pastes. Granule size was measured under the microscope for the same 108 pastes.

Pastes of large-granule fractions thickened at a lower temperature than did pastes of small-granule fractions. Citric acid lowered the temperature of thickening. Sucrose delayed thickening.

The effect of increasing granule size in the absence of citric acid and sucrose was a decrease in maximum and terminal viscosity. In the presence of both citric acid and sucrose, the effect of granule size was reversed because of an interaction between granule size and sucrose.

Maximum viscosity of pastes became higher with the first increment of citric acid and decreased with further increments at all concentrations of sucrose. The effect of sucrose varied with the concentration of citric acid. In the absence of acid, maximum viscosity became progressively higher with the first two increments of sucrose, then became lower with the highest concentration of sucrose. At the other concentrations of citric acid used, maximum viscosity became progressively higher as the concentration of sucrose was increased. Terminal viscosity became markedly lower as concentration of citric acid was increased.

Maximum and terminal viscosity values were higher for pastes of starch from soft wheat flour than for pastes of starch from hard wheat flour and higher for pastes of bleached soft wheat starch than for the same starch unbleached. The evidence is too limited to permit generalization concerning either differences between soft wheat starch and hard wheat starch or the effect of bleach on vis-

cosity of pastes.

Weaker gels were obtained with small-granule fractions than with fractions of larger granules. Sag of gels became progressively greater as the concentration of citric acid was increased and as the concentration of sucrose was increased. The highest concentration used of either citric acid or sucrose prevented the formation of measurable gels. Sag of gels was not affected significantly by source of starch.

If iodine uptake is assumed to represent amylose, the amylose in solution was increased with increasing concentration of citric acid and was decreased with increasing concentration of sucrose. The amount of amylose in solution in relation to gel strength has been discussed. Iodine uptake by soluble material in pastes was not related to granule-sized fraction.

Citric acid at the highest concentration produced fragmentation of starch granules. Sucrose tended to protect starch granules from fragmentation. These effects were reflected by terminal viscosity.

The requirement of at least two factors for gel formation has been suggested: 1) a sufficient concentration of relatively intact granules to provide a minimum amount of rigidity, 2) enough amylose in solution to serve, probably along with amylopectin, as "binding" between the granules.

Because of the existence of interactions between factors, general statements concerning the effects of single factors on the properties of starch pastes and gels are meaningless unless conditions are defined.

82 pages. \$1.50. Mic 56-2631

MANAGERIAL ASPECTS OF FREEZER USE
WITH EMPHASIS ON COOKED AND
PREPARED FOODS

(Publication No. 18,312)

Phyllis Roberta Snow, Ph.D.
Cornell University, 1956

The problem and its treatment

This study was an investigation of the management aspects of meal preparation when a home freezer is available and frozen prepared and cooked foods are used in regular family meals. Representative menus and recipes were prepared by two methods: 1) "bonus cooking," where time for regular meal preparation was extended and some of the recipes were doubled and quadrupled; and 2) "option cooking," where a block of time was used and multiples of sev-

eral different items were made. The extra products were frozen and used in meals served 4 to 6 weeks later. Comparisons were made of the trips made between appliances; clutter at the time of serving; clean-up required; additional equipment, work, and storage space needed; time involved; acceptability of the finished products; and comparative money costs.

Findings

The greatest contribution accruing from the use of frozen prepared and cooked foods was the flexibility in choice of time in which to work and to market, and consequently in the possibility of redistributing the peak loads which generally accompany mealtime.

Savings in preparation time were minor. Compared to the time used for a meal prepared alone, doubling and quadrupling recipes increased the time needed by one-fifth to one-half. One-third to one-half less of the worker's time was required for the meals in which frozen foods were used.

Casseroles required approximately 2 hours to thaw and bake in a preheated oven. Five methods for reducing this time were explored. None provided a completely satisfactory solution. The electronic oven may be the answer.

Five cubic feet of freezer space was suggested as the minimum for an urban family of 4. Frozen food compartments in refrigerators were thought to be inadequate because they were not large enough and the temperature fluctuated easily and was not generally low enough.

No change in appliance relationships was needed but a large counter, where mixing, panning, and packaging could be done, and a cart, to assist in transporting products and to provide counter space at the freezer, were recom-

mended. Freezer supplies were most convenient when in the kitchen and readily accessible to the large work counter.

Some substituting of equipment, particularly of mixing bowls, was necessary when quadrupling recipes though few extra pieces were needed. Each major center needed to be completely equipped even if this meant purchasing 2 or 3 of some small items. Regular pans used in home baking were preferred for freezer storage because they required little handling or replacement.

Clutter and confusion were not necessary with either bonus or option cooking but were difficult to avoid when quadrupling recipes.

Frozen foods did not necessarily save money. Savings were only effected if the food could be had at a bargain for it was necessary to add the cost of containers, storage, and freezing to the cost of the food.

Freezing did not improve any product but all products were appetizing and acceptable. There was a slight drop in the quality of casseroles and 2-crust pies. Losses were chiefly associated with the starchy components -- rice, noodles, mashed potatoes, biscuits, and pie crust -- which absorbed moisture from the sauces or fillings in association with them and became pasty. Methods were suggested for improvement.

In general, quadrupling might be reserved for option cooking and for those items which are served frequently, are expected to taste the same each time, and require little of the homemaker's attention. Doubling is preferred for bonus cooking and for those items with pronounced flavors where frequent repetition would be undesirable.

224 pages. \$2.90. Mic 56-2632

JOURNALISM

A STUDY OF LOCAL REGULATIONS AND GROUP ACTIONS ON THE CIRCULATION OF NEWSSTAND PUBLICATIONS

(Publication No. 18,199)

Don Smith Somerville, Ph.D.
University of Illinois, 1956

This study investigated local regulations and group actions on the circulation of newsstand publications. One purpose of the study was to show the motivations for and the effectiveness of regulation of newsstand publications and to make predictions concerning future restrictive actions. Another purpose was to describe the structure, process of formation, the leaders, and factors of success of organized groups. These groups, active in regulation in South Bend, Indiana, Canton, Ohio, and Detroit, Michigan, supplied the data upon which the analysis was based. Field studies in each of the communities were made by interviewing persons in the regulating group, legal authority, regulated group, and opinion forming group.

Conclusions drawn from the field study in South Bend showed wide-spread indecision of action, disagreement as to standards by which to regulate, apathy on the part of

the total population, and resistance on the part of dealers and distributors. In Canton the effectiveness of the quasi-legal regulation was characterized by acquiescence on the part of the community, cooperation by distributors with the legal authority, non-participation by dealers, and compliance by publishers. The future of regulation in Canton depends upon continuing the present political administration in office and the continuing efforts by those few citizens seeking regulation. Legal regulation in Detroit continues to be successful because of the police Censor Bureau's closely knit operation, almost complete autonomy, acceptance by the community, achievement of cooperation by dealers and distributors, and ability to withstand protest by publishers.

The structures of organized groups in this study were analyzed in terms of time, space, and size. The development of regulation and the compatibility of individual interests with group interests were considered in the section dealing with the process of group formation. From the studies three types of roles of leaders stand out. These are the administrative, the integrative, and the stimulative. It was found that two fundamental requirements were made upon leaders of organized groups. One was that they must carry out their functions in their dual capacities as public

and private citizens. The other was that they must satisfy a diverse membership. The field studies brought out several factors which contribute to the success of regulatory groups. These are that they reflect the temper of the community, they are conservative, and their actions are not viewed objectively. Factors limiting success were found to be that they are structures, they are control agents, their principles become precedents, and they demand constant loyalty.

Conclusions drawn in the light of local regulations and group actions dealt with factors in the disuse of legal procedures, factors in the success of legal regulation, characteristics and requirements of quasi-legal and non-legal regulation, the influence of a variety of publications on regulation, the position that regulation can reduce undesirable behavior, the objective of contemporary regulation, the duality of attitude toward obscenity, factors contributing to regulation and those holding regulation in check, regulatory groups as instruments of social control, the group in relation to the community, the test of value of an organized group, the need of the group to be capable of modification, and factors in the future of organized groups.

It can be hypothesized from the field studies that: regulation is increasingly non-legal in nature; regulatory groups base their actions upon few clearly defined standards; each regulatory action has its origin in an organized group; regulation is generally achieved through public condemnation rather than through legal channels; regulatory actions do not necessarily begin with objections to covers of paper-bound books or pictures contained in "girlie" magazines; regulation does not necessarily proceed from initial objections to pictures to prose content; pressure groups do not speak for the entire minority group of which

they are a part; newsstand dealers acquiesce in the pressure of the regulatory agency and are not necessarily more sensitive to local sensibilities than is the distributor; regulatory action based upon dogmatic content is carried out swiftly and ends abruptly; restrictive action is characterized by rational behavior in the absence of an aroused public; the local articulate public is apathetic toward the importance of regulation; concern by those regulating is short-lived; and in the larger communities the mass media do not necessarily play an integral part in disseminating the issues.

The study was concluded by setting down arguments for and against regulation and recommendations for action. Arguments for regulation are based upon two premises. First, there is a need for protection against pornography. Second, freedom of the press is not unconditional. Arguments against regulation are that no individual or group has the ability to determine what is good literature and what is bad, regulation denies us more than we gain, regulation is generally unworkable, and existing laws are satisfactory. To the federal government it was recommended that there is no need for additional legislation. To local communities it was recommended that available laws be used, substantial funds be allocated to bring "good" reading materials to the youth of the community, and public school systems institute programs of sex education. It was recommended that local law enforcement officials increase efforts to stop the distribution of gross pornography. To newspapers it was recommended that they take a more active interest in local regulations. It is recommended that complete freedom to publish be accorded all publishers and that publishers of proscribed publications defend their publications in court. 252 pages. \$3.25. Mic 56-2633

LANGUAGE AND LITERATURE

LANGUAGE AND LITERATURE, GENERAL

THE CONCEPT OF THE LADY IN THE AMERICAN NOVEL, 1850-1900

(Publication No. 17,536)

Marjorie Arnold Rundle, Ph.D.
University of Cincinnati, 1956

After mid-nineteenth century, the forces released by science, frontier expansion, and growing industrialism necessitated a re-evaluation of various elements in American life, notably the position of women and the leader of women, the lady. This study concerns what the American novels of 1850 to 1900 had to say about the fate of the traditional concept of the lady as a person, first, idle and second, dependent upon man. It was necessary to explore how that tradition found expression in the American novel, how it was attacked, and what constituted the origins and the manifestations of a democratic concept of the lady. In other words, the study is concerned with what the novelists thought happened to the idea of the lady as a symbol of aristocratic privilege when women's role was put to the challenge of democratic equalitarian theory.

The American novels of these fifty years offer an interpretative view of women at probably the most significant moment in their history, the turning point from indirect to direct influence upon their world. A cross-section of the novels--with the exception of the dime-novel--was examined. In the 225 works studied, some five hundred important female characters were analyzed as to position, character, work status, and influence. Of the 57 per cent considered as ladies, the larger number qualified by a definition modified to a greater or lesser degree from the static, traditional concept. Many were democratic ladies: women esteemed for intrinsic qualities of character, irrespective of birth, wealth, or social rank. Certain novelists, especially Southerners, remained loyal defenders of the traditional lady. Others were advocates for the new democratic lady independent of aristocratic tradition yet retaining many of the best qualities of that tradition adapted to the changing times: unselfish concern for the welfare of others, self-respect, honor, and intelligence or adaptability. The refinement, tact, and ability to please so valuable to the dependent lady became invaluable aides to the new lady, who often found herself in situations with no precedent to guide her. The character who qualified as a democratic lady entered the workaday world, for example,

as a scarcely welcome intruder. Regions outside the strongholds of traditional ladyhood (the city and the plantation South) tended to foster an independence of spirit which served just as well as employment outside the home to modify the concept of ladyhood.

The traditional norms of appearance, conduct, and character were often referred to by the advanced social thinkers in their search for a satisfactory definition of ladyhood. Similarly, traditionalists wishing to retain the concept of a lady of leisure and privilege created heroines of individual merit. There resulted frequently an ambivalence of concept testifying to the complexity of determining the role of the lady in meeting the multiple demands of home and children, the community, and her continuing development for the benefit of both. As Howells, James, and others noted, the old and the new concepts of the lady came into conflict in Europe, and such writers explored this conflict to illuminate their own definitions of the American lady.

In sum, most novelists, both men and women, seemed willing to relinquish part of the tradition of ladyhood. They posited a modified concept influenced by theory, practical observation, and/or wishful thinking about a democratic society. Assuredly the lady survived in the novels, a vigorous and hopeful figure, though the direction and extent of her role in the complex mechanical age had not yet been fully ascertained. 356 pages. \$4.55. Mic 56-2634

CHAUCER AND DANTE: A REVALUATION

(Publication No. 17,272)

Howard H. Schless, Ph.D.
University of Pennsylvania, 1956

Supervisor: Dr. Albert C. Baugh

It has been the endeavor of this study to investigate contextually the literary relationships between Chaucer and Dante. To this end, the biographical problem of the time when Chaucer could have learned Italian or discovered Dante has been set against the relevant social background. The suggestion of a period prior to the 1372 journey to Italy would seem to receive support from the discussion of the date of the *Hous of Fame*, which may well have been written in the mid-70's. Naturally, such an hypothesis militates against the "triplicity" of Chaucer's works and, to a certain extent, against the concept of Dante as the precise cause of an immediate and profound change in Chaucer. That a new direction resulted from Chaucer's exposure to Italian seems virtually certain and, in order to have some basis for evaluating the degree of this change, the more obvious poetic techniques of the *Roman de la Rose* and the *Divina Commedia* have been compared with relation to Chaucer.

The major emphasis of this paper has been, of course, the literary relationships of the two writers. To determine the extent of this dependence and to avoid the danger of unfounded generalizations, all reasonable ascriptions to Dante have been set out in context beside the relevant lines from Chaucer. Here, again, the intention has been to in-

vestigate the specific lines not only in the context of the passage but in the light of contemporary literature and thought as well, for the encyclopaedic nature of Dante's poetry and the assimilative quality of Chaucer's make comparisons *in vacuo* particularly dangerous. Ascriptions may be made on the basis of: (1) direct translation or citation (in which case there are no difficulties); (2) verbal parallelism; (3) thematic parallelism. These last two, in combination, offer very strong evidence of dependence; separately, however, some unique feature of word or thought seems necessary to avoid merely weak analogy. Each entry has been evaluated by this standard and, when necessary, a comparison has then been made with other possible sources.

Speaking in most general terms, Chaucer's literary indebtedness seems to fall into two main categories. (1) Most striking are the longer translations borrowed principally for purposes of their content. With the exception of the Ugolino episode, Chaucer seems to have turned to Dante for certain specific topics: to *Convivio IV* for the discussion of nobleness, and -- earlier -- to the *Paradiso* for the lyric expression of religious adoration. However, one purpose of this study has been to show that Chaucer turned to other sources as well, combining and molding the whole to fit the thematic purpose of the individual poem. (2) Far wider is Chaucer's borrowing of images of verbal or dramatic force. While these come from throughout the *Divina Commedia*, they are at first drawn chiefly from the beginning and end of Dante's three *cantiche*, with particular emphasis on the opening cantos of the *Inferno*. Once more, however, this summary leaves out a large number of borrowings in order to give a more general view of the direction of the indebtedness.

Chaucer, it would seem, remained always in control of his material. While both men saw poetry as existing in the "world of affairs" rather than that of stylized conventions, Chaucer did not copy Dante poetically, nor is his poetry (albeit moral) the expression of a fiercely held doctrine, as was Dante's. To consider that Chaucer, when borrowing an image or even a phrase, of necessity accepted the doctrine which informed it, seems highly questionable. Chaucer drew on Dante not heavily but over many years, principally for the striking images that help make Dante's poem the masterpiece that it is. Chaucer, however, remained a poet primarily interested in people and not doctrines; when he borrowed from Dante's universal vision, he took that which helped him explain the world of men of which he was so much a part and of which he is so much a symbol. 445 pages. \$5.70. Mic 56-2635

THE UNIVERSITY OF PENNSYLVANIA MANUSCRIPT OF THE OLD FRENCH BLANCANDIN ET L'ORGUEILLEUSE D'AMOUR WITH A STUDY OF THE MANUSCRIPT RELATIONS

(Publication No. 17,283)

Franklin Pratt Sweetser, Ph.D.
University of Pennsylvania, 1956

Supervisor: Dr. William J. Roach

The purpose of the present study of the romance

Blancandin et l'Orgueilleuse d'amour is first, to give a preliminary edition of the text of the University of Pennsylvania manuscript, and second, to determine the relationship of this manuscript to the other verse manuscripts, and finally, to evaluate what is known at present about the date, authorship and literary connections of the work.

A complete collation was made of the following verse manuscripts: A (19152, Bibliothèque Nationale, Paris), C (375, Bibliothèque Nationale, Paris), F (fragment published in Romania, 1889) and P (French ms 22, University of Pennsylvania, Philadelphia). P, a recently discovered manuscript, lacks the beginning and the end of the poem, and in its present state, contains 5,548 lines, written in an eastern dialect. B (L. V. 44, Turin) was destroyed by fire in 1904, therefore only the incomplete variants given in the Michelant edition of C could be consulted. In the transcription of ms P, no variants have been given. No attempt has been made to emend it, except in the case of obvious scribal errors, which are indicated at the foot of the page where the change has been made.

The results of this collation showed that C is a less amplified redaction than A and P, which, together with B, must have come from a common source different from that of C and F. F shows evidence of being the most amplified of all the redactions, as it contains episodes not found in the others.

The fact that A, the truncated version, agrees so closely with P and B, which in turn agree in many places with both C and F leads to the conclusion that the independent dénouement of A was the work of a later reviser.

The date of composition for Blancandin is probably within the first third of the thirteenth century, judging from linguistic traits and characteristics of other romances of a similar type written in that period. There is no evidence as to the identity of the author, therefore, the work must be considered anonymous. The most obvious literary influence on Blancandin was Chrétien's Perceval, but only in the early episodes. Blancandin is classed as a model of the adventure romance genre, with certain details of epic origin. It is closer to the earlier courtly romances and Byzantine adventure romances than to the Arthurian romances. Its chief merit as a literary composition is the portrayal of feminine psychology, depicted realistically, and often humorously.

326 pages. \$4.20. Mic 56-2636

STUDIES IN CHAUCER'S IMAGERY

(Publication No. 17,455)

William Allen Tornwall, Ph.D.
Louisiana State University, 1956

Supervisor: Professor Thomas A. Kirby

This investigation of Chaucer's figurative imagery is based upon an examination of all the poems exclusive of the somewhat doubtful Romaunt of the Rose. The discussion is presented in an introductory chapter and a series of related essays, each of which treats a different aspect of the poet's figurative language.

The first essay, "Chaucer's Imagery and the Colors of Rhetoric," shows that Chaucer makes use of all the figura-

tive devices recommended in the medieval treatises on rhetoric, though such colors as translatio, allegoria, and similitudo are found to be of much greater importance for the expression of imagery than most of the others.

The second essay, "The Appropriateness of the Subject Matter in Chaucer's Imagery," demonstrates that although his images characteristically contain a mixture of subject matter more or less fitting to his informal, conversational style, the materials in the imagery of the House of Fame, of the Prologue to the Legend of Good Women, and of the General Prologue to the Canterbury Tales are appreciably influenced by the character of the poems. Further, it is shown that the imagery in the Reeve's and the Wife of Bath's prologues reflects the background character of the poems. Further, it is shown that the imagery in the Reeve's and the Wife of Bath's prologues reflects the background and occupation of the speakers and that in the tales of the Knight, the Miller, the Reeve, and the Nun's Priest the subject matter in the figures is especially fitting not only to the character of the poems but to the narrators as well.

The next study, "Chaucer's Treatment of Derived Imagery," illustrates the poet's widely diverse methods of adaptation, which range all the way from the occasional instances in which images are shortened to the large number in which they are greatly extended, from those that closely reproduce a model to those that give independent development to a mere hint or suggestion, from the few which render an image less specific to the many that are made more definite. The striking originality which Chaucer so often achieves in his treatment is discovered to result for the most part from his numerous additions of concrete details.

The fourth essay, "The Imagery in Chaucer's Portraits," shows that the descriptive passages of this kind commonly contain an astounding abundance of imagery in all periods of Chaucer's poetry and that this imagery is of a functional character. Moreover, the imagery thus employed is found to manifest a development through the successive poems both in the particular functions which it serves and in its degree of suggestive power.

The final essay, "Chaucer's Attitude Toward Imagery," attempts to demonstrate that the poet's scattered and fragmentary comments on poetic art, though insufficient to construct a complete and hard-and-fast theory of imagery, seem to indicate (1) that Chaucer does not look with disfavor upon figurative language and the colors in general as some scholars have supposed, (2) that he sanctions a functional use of imagery, (3) that he favors materials which are at least in a general way appropriate to the character of a poem and to a narrator, (4) that he considers old books the chief source of images, though he recognizes the importance of oral materials and first-hand observation, and (5) that he realizes the value of visualizing imagination in the creation of imagery. These critical ideas are found to accord with the conclusions reached in the preceding essays concerning Chaucer's actual practices.

364 pages. \$4.65. Mic 56-2637

LANGUAGE AND LITERATURE, CLASSICAL

CONTRIBUTIONS TO THE STUDY OF
THE THOMAN RECENSION OF AESCHYLUS

(Publication No. 18,118)

Elizabeth Agnes Emily Bryson, Ph.D.
University of Illinois, 1956

The most widely dispersed and the most influential of the Byzantine editions of the triad of Aeschylus (Prometheus, Septem, Persae) was that of Thomas Magistros which appeared in the years between 1290 and 1300. Alexander Turyn, in The Manuscript Tradition of the Tragedies of Aeschylus (New York, 1943), was unable to investigate exhaustively the Thoman recension since photostats of a representative number of Thoman manuscripts were not available at that time. This dissertation is intended to supplement his work with a more detailed examination of the Thoman recension than he was able to present. The conclusions are based on collations of seventeen manuscripts: nine Thoman (FbFcKLLcLhQRaRb), five old (MAVBH), one Triclinian (T), and two which are basically old but contaminated by Byzantine influences (NcP).

The main problem of the Thoman tradition is the lack of uniformity among the many Thoman manuscripts. There is a Thoman version of the Vita and the arguments, and a corpus of Thoman scholia distinct from those of the genuine tradition, as well as a heavily interpolated poetic text. But few manuscripts are completely Thoman in all their elements. The poetic texts of Thoman manuscripts are also very undisciplined, and it is difficult to imagine how they could all be derived from a single source, the presumptive autograph of Thomas.

One of the outstanding reasons for this confusion is that the Thoman recension was completed in two separate phases, a first and a second edition. The existence of these two editions is demonstrated in the present dissertation. The first edition today is represented by only one manuscript--- Lc. The main body of the work in the two editions is the same: the Vita, arguments, and scholia were only slightly modified in the second edition, and the majority of the important Thoman textual interpolations appear both in Lc and in manuscripts of the second edition.

The second edition of Thomas was originally preserved in a master copy in which Thomas recorded quite fully the variations present in his sources. Each scribe copying this manuscript made his own choice among the variants, and also added a few interpolations of his own in some cases. These two practices, plus the factor of two separate Thoman editions of the triad, account for the general confusion within the Thoman tradition.

The lists of Thoman readings presented in this study are divided into three groups: readings unique to the first edition (Lc), readings common to both editions, and readings found only in manuscripts of the second edition.

The editing technique of Thomas Magistros in general was based on a desire to clarify the text. But his frequent substitutions of words, synonyms and otherwise, were whimsical and done according to the fashion of that time.

Many Thoman interpolations have been accepted in printed editions, usually because they effect obvious corrections of, or improvements on, the transmitted "old" text. But hitherto the Thoman influence has not been realized and acknowledged even by modern editors. Only by

thoroughly investigating the characteristics of the Thoman recension can contaminated manuscripts and their interpolations be surely identified and discarded in our efforts to restore the genuine text of Aeschylus.

A short discussion of the Triclinian edition has been included in this dissertation inasmuch as it constitutes a development of the second Thoman edition, and a list of outstanding Triclinian interpolations is given. The manuscripts used for the study are described in an appendix, and incidental information discovered during the course of research is presented with the individual descriptions of manuscripts. 169 pages. \$2.25. Mic 56-2638

HISTORICAL COMMENTARY DRAWN FROM THE
NATURAL HISTORY OF PLINY THE ELDER
FOR THE YEARS 54-76 A. D.

(Publication No. 17,234)

Rev. Charles H. Herkert, O.S.F.S., Ph.D.
University of Pennsylvania, 1956

Supervisor: William C. McDermott, Ph.D.

In writing the Historia Naturalis Pliny did not intend to write a history of his own times, nor of earlier times. Nowhere in the preface or table of contents does he give any intimation that he intends to write a history, as such. However, in a great many places throughout the entire encyclopedic work he introduces historical references, mentions historical facts, relates historical anecdotes, and attempts to correct errors in the historical accounts of others. It is the purpose of this dissertation to evaluate what Pliny said about the period from 54 to 76 A.D., i.e. from the reign of Nero to that of Vespasian, and then to annotate these statements, especially in the light of the other ancient sources.

It was first of all necessary to read through the entire 37 Books of the Historia Naturalis, noting carefully every part of the text that contained any reference to historical and related data. Then each of these items was compared with the other ancient writers, especially with Suetonius, Tacitus and Dio. Modern works and authors were used only in so far as they supply or supplement the ancient sources. Any contradictions, real or apparent, were considered and an attempt was made to solve such difficulties. Textual difficulties were considered only in so far as they had any bearing on the historical references. The text quoted is always that of the Teubner text of Jan-Mayhoff, and all conjectures are made in the commentary. There are 90 separate articles in the dissertation, each one containing the text, a translation, and a historical commentary.

In the reign of Nero Pliny treats such events as the fire in Rome, the attempt to cut a canal through the Isthmus of Corinth, the granting of freedom to all Achaia, a proposed attack on Ethiopia and the Caspian and Caucasian Gates. Comments are also made on Nero's singing, acting, and driving in chariot races. Every one of these items, and others, receives the most unfavorable treatment possible from Pliny. Vespasian, on the other hand, is always referred to in highly complimentary terms, usually in connection with his building program, especially his Tem-

ple of Peace. Titus, to whom the *Historia Naturalis* is dedicated, also receives favorable treatment. Galba, Otho, and Vitellius receive scant mention: Galba for including several Gallic tribes in Gallia Narbonensis, Otho for his friendship with Nero, and Vitellius for his luxury and extravagance. Poppaea comes in for several rather sarcastic remarks. Many other persons of historic importance are also mentioned by Pliny, especially Corbulo, Mucianus, Seneca, Serenus, Silanus, Domitian and others.

Pliny was found to be a reliable, trustworthy historian; in no place was he found to be in error when compared with the other sources. However, he does let his prejudices influence his judgments and interpretations of the historical facts he relates. Another influencing factor is his acceptance of omens, portents, and prodigies, although this is no more noticeable in him than in the other ancient writers.

133 pages. \$1.80. Mic 56-2639

LANGUAGE AND LITERATURE, LINGUISTICS

SIERRA POPOLUCA MORPHOLOGY

(Publication No. 18,296)

Benjamin Franklin Elson Jr., Ph.D.
Cornell University, 1956

Sierra Popoluca is an American Indian language spoken in the state of Veracruz, México. It is a member of the Zoquean language family.

The morphophonemics, inflection, and derivation of the language are considered.

Three types of morphophonemic alternations occur in Sierra Popoluca: regular alternations, which are defined as phonemic replacements that occur between words as well as within words; stylistic alternations, which occur only between words; and irregular alternations, which occur only within words.

Sierra Popoluca contains three morphemes composed only of sequences of stress phonemes, these are termed superfix morphemes.

Four inflectional systems are recognized: word inflection, substantive inflection, numeral inflection, and verb inflection. The word-inflection system contains suffix morphemes which occur with all word classes, including many particles. Three stem classes, particles, adverbs, and participles, are inflected only with word inflection. These stem classes differ from each other in their internal composition. All other stem classes differ from each other by their occurrence with different inflectional systems.

There is an inflectional subsystem, the person markers, that is part of each of the other three inflectional systems (i.e. except word inflection). The person marker subsystem contains nine members grouped into three sets. Besides person, the members of set I mark 'participant', the members of set II mark 'associate', and the members of set III mark 'participant and associate'. The term 'participant' is used to denote the person most closely connected with the situation spoken about. In English glosses the participant is the subject of an intransitive verb, the object of a transitive verb, the subject of an equational

sentence, and the subject of a passive sentence. The term 'associate' designates the person somewhat more removed from the situation. In English glosses the associate is the subject of a transitive verb, and the possessor of a noun. In Sierra Popoluca the set used to mark associate is also used, where possible, to mark subordinate constructions.

The substantive-inflection system includes the person markers, pluralizing suffixes, and locative case endings. The division of substantives into subclasses is based primarily on their occurrence with the person marker sets. The subclasses so delineated are: nouns, pronouns, nominatives, adnouns, and adjectives.

The numeral-inflection system is distinguished from the substantive system (numerals occur with many affixes of the substantive system) by two special affixes. One of these is obligatory to the occurrence of a numeral. The numeral class is very small since the old Sierra Popoluca number system has almost vanished, only numbers 1 through 5 being in common use. Numerals borrowed from Spanish are ordinarily used, and these are members of the adjective class.

Verb stems fall into two classes: transitive and intransitive. Some verbs are members of both classes. Verbs are inflected for reference (person reference and syntactic reference) and for mode-aspect. Two orders of prefixes and six orders of suffixes comprise the verb-inflection system.

Sierra Popoluca contains four derivational systems: verb derivation, substantive derivation, adverb derivation, and participle derivation.

The verb-derivation system is the most elaborate. Three types of stem formation are recognized: outer formations, compounds, and inner formations. Seven affix morphemes are termed outer affixes. These are very productive, almost like inflection.

Compounding is also a very productive method of forming verb stems in Sierra Popoluca, and several methods of compounding occur.

Inner affixes include those which derive verb stems from nonverbs, and a few that occur only with verb roots.

Substantive derivation includes a few affixes that occur with substantive stems to form other substantive stems, and others that occur with verb stems to form substantive stems. Compound substantives also occur.

Adverbs are derived by means of a single suffix -kay.

Participles are derived from both verbs and substantives by means of suffixes.

Two short Sierra Popoluca stories are presented and analyzed to illustrate the morphological system that has been described.

217 pages. \$2.85. Mic 56-2640

PRIMITIVE GERMANIC ⁺kuningaz AND ITS SPREAD

(Publication No. 17,240)

Antanas Klimas Ph.D.
University of Pennsylvania, 1956

Supervisor: Professor Alfred Senn

The basic task of this study is to determine the original meaning of Prim. Gmc. ⁺kuningaz, ⁺kunungaz. In order to achieve that, the basic meaning of the Prim.

Gmc. suffixes -ingaz and -ungaz has to be determined. For this purpose all available -ingaz and -ungaz formations in Gothic, OHG, OS, and OE are listed and discussed. Most characteristic examples of ON are also listed, with very brief explanations. Then the basic meaning of the two suffixes is established, and the original meaning of Prim. Gmc. *kuningaz is determined.

The spread of Prim. Gmc. *kuningaz is discussed from two sides, i.e., its spread in the Germanic languages and in non-Germanic idioms: Finnish, Slavic, and Baltic.

Only two words with the suffix -igg- have been recorded in Gothic. There are no -ugg- formations recorded in Gothic documents. OHG has many more -ingaz formations, and the situation is similar in OS and in OE. All of these also have several -ungaz formations. There are very many -ing- and -ung- formations in ON, many of which are of later development.

It is shown in this study that there was no difference in meaning between Prim. Gmc. -ingaz and -ungaz, although -ingaz formations do occur much more frequently.

The meaning of the Prim. Gmc. suffixes is established as follows: attached to a nominal word, the suffixes -ingaz and -ungaz formed a) a masculine noun with the sense of "one belonging to", "of the kind of", hence "one possessed of the quality of"; b) as a pure patronymic "one descended from, a son of".

Prim. Gmc. *kuningaz belongs to the first group. It was derived from Prim. Gmc. *kunja "family, tribe", and meant originally "a member of a family, tribe".

This man from a tribe used to be elected to be the chief official of the tribe. The word *kuningaz underwent the following semantic changes: "a man from a family, tribe" > "a man from an influential family, tribe" > "a man from (an influential) family, tribe elected to be the chief official of the tribe" > "a chieftain" > "ruler" > "king".

The institution of the Germanic kings was necessitated by the social and political situation. *kuningaz has no sacred origin.

Finns borrowed Prim. Gmc. *kuningaz from the early Goths, or from another Germanic tribe, where Prim. Gmc. was still spoken. This borrowing occurred in the area of East Prussia ca. 500 B.C. - 100 A.D.

The Slavs borrowed this word from one of the continental Germanic tribes ca. 600 A.D.

The Old Prussians got their konagis "king" from the Teutonic knights in East Prussia in the first half of the 13th century. It is either MHG or Middle German.

Lith. kunigas "priest" was taken from Livonian German (MHG) soon after 1200 A.D. Lith. kunigas so often quoted as Prim. Gmc. loanword in Lith. does not exist in Lith. writings until the 19th century. It is only a later development of Lith. kunigas in the dialect of West Samogitian.

Le. kungs "Herr" also comes from Livonian German soon after 1200 A.D. It is also a MHG loanword.

110 pages. \$1.50. Mic 56-2641

NEGATIVE CONTRACTION WITH OLD ENGLISH VERBS

(Publication No. 17,244)

Samuel R. Levin, Ph.D.

University of Pennsylvania, 1956

Supervisor: Harold S. Stine

Contraction of the negative particle (ne) with a following verb reaches a distinctive stage of development in Old English, taking place with four of the most important verbs in the language, namely, habban, willan, witan, and wesan (subsumed under wesan are the substantive forms eom, eart, and is), and resulting in forms like næbbe, nylle, nite, næs, etc. Contractions of this type (showing what is herein called grade three of contractive force) are distinguished from forms like Lat. nescio and Goth. nist < *ne ist (grades one and two respectively) in that the contractions of grade three have to suppress an [h] or a [w]. In respect to these contractions of grade three, Old English is paralleled by Old Frisian. In no other Indo-European language, however, did negative contraction with a following verb reach a stage of development comparable to what is found in Old English and Old Frisian.

The distribution of contraction versus non-contraction (the two elements do not always contract) is first examined in Early Old English prose texts. It is found that, in West Saxon, contracted usage predominates. In Mercian the evidence points to a much freer employment of uncontracted forms. In Northumbrian the data point to a preference for contracted usage.

The distribution is next examined in texts of Old English poetry. There it is found that contraction is favored over non-contraction much more strikingly than was evident for the prose. Of the uncontracted forms, many can be explained as necessary either for purposes of alliteration or for filling out the syllable-count so as to make the half-line conform with a regular Sievers Type. The small remainder of uncontracted forms, those that cannot be rationalized by means of alliteration or syllable-count, are ascribed to prosodic principles governing longer contours. The conclusion is reached that contractions of the type under investigation were developed by the poets in order to reduce, by a syllable, forms that were of a lesser importance, metrically.

Late West Saxon prose shows a development of the feature of contraction to a point where uncontracted forms hardly appear; in late Mercian, however, they are quite common. This pattern of contraction in West Saxon against contraction/non-contraction in Mercian adumbrates a distribution which, in Middle English, attains the status of an isogloss: in those dialect areas carrying on the West Saxon literary tradition, i.e., Southern, Southwest Midland, and West Midland, the usage is almost entirely in favor of contraction; of four hundred and ninety-six relevant forms noted (from poetry and prose), only two are uncontracted. In East Midland and Northern, on the other hand, the usage is roughly fifty-fifty.

In late Middle English texts the contractions are found to become less and less numerous. The falling off in the occurrence of these contractions coincides largely with the replacement of ne by other forms of negation; the latter process being virtually completed by the fifteenth century. Only two forms showing the contraction, willy-nilly and hob-nob, have survived into Modern English.

93 pages. \$1.50. Mic 56-2642

CRITERIA FOR THE DETERMINATION OF SLAVIC BORROWINGS IN LITHUANIAN

(Publication No. 17,273)

William R. Schmalstieg, Ph.D.
University of Pennsylvania, 1956

Supervisor: Dr. Alfred Senn

The purpose of this dissertation is to establish criteria which can be used to determine Slavic borrowings in Lithuanian. Loanwords are the principal subject of the paper, but attention is also given to other types of language influence, such as Slavic influence on Lithuanian syntax, morphology and phonetics.

The first part deals with the problem of bilingualism and it is established that when bilingual populations exist there is a tendency for them to bring their languages into conformity, i.e. one basis of articulation is established, phonemes are borrowed and language influence is found at all levels.

The criteria for the determination of borrowings include linguistic analysis of loanwords and a study of the close political and cultural ties between Slavs and Lithuanians. In general well documented explanations which are closer in regard to time and space are preferable to those extending into the distant Indo-European past about which we have no certain knowledge. Also words which form part of a group of borrowings in a given cultural area are more likely to be loanwords.

As a result it is noted that certain of the linguistic criteria hitherto applied for the determination of borrowings, such as the existence of different ablaut forms in related words and evidence of the pitch accent are insufficient. Cultural and historical factors must be given prior consideration.

148 pages. \$1.95. Mic 56-2643

LANGUAGE AND LITERATURE, MODERN

CHARLES KINGSLEY AND THE INDUSTRIAL REVOLUTION

(Publication No. 17,172)

Richard Eilers Allen, Ph.D.
Washington University, 1956

Chairman: George D. Stout

The purpose of the study is to examine in detail Charles Kingsley's protest against the physical, moral, and spiritual condition of the newly industrialized society in which he lived. Two separate approaches are taken toward this end, one chronological, the other comparative and analytical. The chronological material is an account of Kingsley's life and work, with a marked emphasis upon his interest in social and industrial affairs, and upon the portion of his life (extending roughly from 1844 to 1854) devoted to active protest. The second, or analytical half of the study is a comparison of Kingsley's social creed with those of his acknowledged "prophets," Thomas Carlyle

and Frederick Denison Maurice.

By the time Kingsley took Holy Orders in the Church of England in 1842, he had found in Carlyle and Maurice a gospel of unity and purpose in God's universe which helped to rescue him from youthful religious despondency and spiritual isolation. In his two prophets he also found a doctrine of social duty, which opposed to the mechanical, competitive, individualizing creed of *laissez-faire* political economy the necessity for disciplined organization, cooperation, and permanence in the relationships of men. In the novels *Yeast* (1848) and *Alton Locke* (1850) Kingsley tried to reveal dramatically the physical and moral degeneration of the working-man under the competitive system and pleaded for an awakening of social responsibility among the upper classes. Under the pseudonym "Parson Lot" he also wrote extensively for the Christian Socialist publications *Politics for the People* and the *Christian Socialist*, directed at the working classes themselves. Although "radical" in the sense that it strongly opposed orthodox political economy, Parson Lot's message to the English laborer was essentially conservative in tone; he asked the workman to forego his demands for political "rights" until he truly deserved them, to avoid any rash actions which might destroy the traditional structure of society, and to place his trust instead in those members of the aristocracy and clergy who were beginning to recognize their social obligations.

Most of the details of Kingsley's social gospel are strikingly similar to what he found in Carlyle's works. Like Carlyle, Kingsley bitterly attacked materialistic Mammon-worship, the Utilitarian morality of enlightened selfishness and its economic counterpart in the competitive system, and the mechanistic view of society which led to "Morrison's Pill" remedies and panaceas. Like Carlyle, he found hope for social regeneration only in individual moral reform, which would lead to a recognition of each man's duties and responsibilities and thus to a future society not of nomadic, self-seeking particles, but of organically related members bound together by sympathy and corporate feeling. In Maurice's work, too, the emphasis was upon the corporate nature of society, divinely ordained by a God who intended Christ, rather than the rebellious Adam, as the archetype of humanity. In the Maurician concepts of earth as the Kingdom of Christ, and of the Universal Church as society in its perfect form, Kingsley found the theological basis for his social arguments. To Maurice, and to Kingsley after him, man's choice was a simple one: either he could deny his kinship with God through Christ by asserting his own interests ahead of his brother's; or he could acknowledge the Kingdom of Christ on earth by submerging his will into that of God and of the society which God created.

249 pages. \$3.25. Mic 56-2644

THE TREATMENT OF HISTORY IN THE WORKS OF GERTRUD VON LE FORT

(Publication No. 17,527)

Anne Frances Baecker, Ph.D.
University of Cincinnati, 1956

This dissertation, the second in the United States on the contemporary German writer, Gertrud von le Fort, pre-

sents the historical background of her chief works. In examining the narratives in question, the historical data were divested of the purely imaginative descriptions as far as this was possible.

Le Fort's conception of universal history is based on a theistic Weltanschauung. In a synthesis of truth and fiction, the author interprets the events of the past. Though man is endowed with a free will, all of man's actions are governed by Divine Providence.

The introduction of this dissertation gives a brief description of Le Fort's family background, followed by a classification of her writings and an evaluation of the books and dissertations written on the works of the author.

In the second chapter an attempt is made to give an interpretation of universal history on a theistic basis, as distinguished from a purely rationalistic philosophy of history. It is shown that since Bossuet's *Discours sur l'histoire universelle* (1681) a theology of history, based on revelation, has often been replaced by a belief in secular progress.

The third chapter deals with the conflict between faith and skepticism of our own times, as reflected in the two novels *Der Roemische Brunnen* (1928) and *Der Kranz der Engel* (1946). Like her teacher, Troeltsch, Le Fort believes that the Christian faith upholds our western culture.

Chapters four to six give an analysis of the author's historical narratives. The historical events of these writings are those of consequential schisms. In *Das Reich des Kindes*, the period of 887-911, the decline of the Carolingian dynasty brought about a partition of central and southern Europe into a number of independent states. The dethronement of Charles III caused a reaction against the idea of a universal empire. In *Die Magdeburgische Hochzeit* (1938), which tells of the destruction of Magdeburg during the thirty years' war, we learn of the causes that resulted in the disintegration of the Reich and widened the gap between the Catholic and Protestant faiths. The period involved in *Der Papst aus dem Ghetto* (1931) is that of the dispute concerning the investiture, which increased the prestige of the papal seat outside of Rome, but resulted in the control of the tiara by the Roman nobility. The ambitious striving of the Pier Leoni reached its climax in the election of Anaclet II, which caused the schism of 1130.

The essence of Le Fort's writings lies in a combination of reports of empirical facts and a subjective evaluation of the historical events. The preliminary work for her creative writing was basically that of a historian. However, in her intuitive penetration of the historical characters, her writing becomes "Dichtung." The purely fictional parts of the narratives elucidate the metaphysical. The ever-repeated theme in her narratives is the acceptance or rejection of the Christian faith.

Le Fort's writing is that of a mystic realism. The whole history of the world is directed toward a God-predestined teleology. Human acts are evaluated according to their participation in the fulness of eternity by completing the passion of Christ. Hence Le Fort's belief that everything has an infinite consequence.

271 pages. \$3.50. Mic 56-2645

**"TO ALL THE PEOPLE OF BROOKLYN":
WHITMAN AS EDITOR OF THE
BROOKLYN EAGLE, 1846-1848**

(Publication No. 17,434)

Thomas Lowber Brasher, Ph.D.
Louisiana State University, 1956

Supervisor. Professor Lewis P. Simpson

No complete portrait has been drawn of the Walter Whitman who edited *The Brooklyn Daily Eagle* during two years, 1846-48, which lay in the decade preceding his self-apotheosis as "Walt Whitman, a kosmos." Several valuable selected collections of the *Eagle* writings exist, but their incompleteness has led those who have depended upon them for interpretations of the Whitman of the *Eagle* to draw insufficiently supported or mistaken conclusions. This study proposes, by an exhaustive examination of the *Eagle* for 1846-48, to present a thorough picture of Whitman as editor of the *Eagle*, and, in so doing, vindicate his reputation as a professional journalist and determine the extent to which his writings of that period foreshadow the future poet of *Leaves of Grass*.

The files of the *Eagle* have furnished the material—much of it heretofore unnoticed—for Whitman's portrait: his editorials, paragraphs, news stories, commentary, and reviews. His concept of the duties of an editor, his relationship with his fellow editors, and his urban (and rural) environment have been reconstructed from this material. His reactions to the political and economic scene display his attitude toward manifest destiny, Europe, local and national government, the Democratic-Republican Party, banks, currency, wage-earners, and immigrants. His criticism of the social scene reveals his varied response to crime and its punishment, policemen and firemen, education, temperance, slavery, poverty, religion, health and doctors, the insane, the blind, women, and even horses. A significant element, too, in the portrayal of the young editor is his remarks on literature, drama, music, ballet, and the fine arts. Most of the aspects of the "Roaring Forties" are examined by the *Eagle* where, through the catalysis of its criticism, they combine to form a consistent and believable likeness of Walter Whitman, Esq.

The portrait that emerges is one of a journalist who, though conventional, is entitled to respect as one who enjoyed his profession, took it seriously, and devoted it to an earnest purpose. Whitman liked his duties as editor, reporter, and reviewer, and he liked talking "on many subjects, to all the people of Brooklyn." He believed that the major responsibility of an editor was to school the "newspaper-ruled" people; and the persistent didacticism in the *Eagle* is evidence of his professional earnestness. Though he supported the conventional moralities, he was no mere conformist. On occasion, he advocated views unpopular not only with his readers but with his party and his employer as well. Somewhat a reformer and an advocate of radicalism in politics, Whitman himself was preserved from radicalism by his antipathy toward fanaticism, his skepticism of perfectionist theories, and his fundamental belief that the best society is that with the greatest freedom from restrictions imposed by either legislative bodies or interested groups. This last he considered an "immutable truth," and it gave him a touchstone by which to appraise the social, political, economic, and to a degree,

the artistic phenomena of the 1840's, imposing a certain unity on the varied commentary in the *Eagle*. This "immutable truth" was later an important motif in the *Leaves*. The writings in the *Eagle* also show that the psychological foundation for the mother-worship motif in the *Leaves* was already firmly established by 1846, that Whitman was being prepared to accept the polarity of good and evil in the *Leaves*, that his later theory of national literature was in its half-formed but generative "embryons," and that the things the young editor saw, heard, and read were being unconsciously stored in his memory as raw material for his later poetry. 333 pages. \$4.30. Mic 56-2646

METHOD AND FORM IN THE NOVELS OF JOSEPH CONRAD

(Publication No. 17,436)

Harold Edmund Davis, Ph.D.
Louisiana State University, 1956

Supervisor: Professor Nathaniel M. Caffee

In the considerable body of criticism written about almost every aspect of the novels of Joseph Conrad, there is a noticeable lack of comment about his technical methods, even though it has been a commonplace of literary history that his techniques were experimental to a greater degree than those of most of his contemporaries. Past criticism has also failed to place his whole approach to method into a clear relationship to any traditions of the English novel, or to find any influences which may have led to his technical experimentation. His work has been grouped loosely with "travel" literature popular at the close of the century, with sea and "Romantic" novelists, or the problem of classification has been avoided by considering him an unexplainable phenomenon, a foreigner writing in a language not his own and with roots in a tradition not native to English. However, if Conrad's reputation as a highly skilled novelist is to be thoroughly understood and his position to be fixed in the history of the novel, it is necessary to face directly the problems of technique and method.

The purpose of this study, then, is twofold: first, to look more closely at Conrad's contemporaries, those writers with whom he associated himself, and discover some evidence about their methods, their self-styled literary impressionism; second, to analyze Conrad's twelve novels in terms of their style, symbolism, and structure, and arrive at some conclusions about his technique and its place in relation to the stream of the English novel.

Literary impressionism, as it was defined and practiced by Ford Madox Ford, Henry James, Stephen Crane, W. H. Hudson, and Joseph Conrad, was not a deliberately organized literary movement. Rather it was a loosely connected group of views which saw the novel not as a series of external events, but as an attempt to present the reaction of those events upon the actors in them; it placed great emphasis upon the rendering of experience with the dramatic immediacy with which it strikes the mind; and, perhaps of greatest historical importance, it saw the novel as a conscious art form with unity and coherence organic in its nature.

In style, Conrad varied considerably from the goals of economy and simplicity held by his Impressionist contemporaries. Possibly because of his unusual language background, his prose style is essentially a calculated, "rhetorical" style, a deliberate use of language for its inherent effects, although there is, in his work, a development towards a more functional prose, best illustrated in *The Rover* (1923). The same calculated quality is evident in the rich symbolism in his novels, particularly in the early *Almayer's Folly* (1895), and *An Outcast of the Islands* (1896), although the use of color and atmosphere symbolically in all of his novels is soundly based in impressionism.

It is in his structures that Conrad shows clearly his debts to impressionism and his influence upon a tradition which underlies the modern novel. Through his experiments with point of view, time shifts, and dramatic projection, he throws the emphasis upon the effect of action rather than upon action itself. Instead of the conventional chronological progression, Conrad employs juxtaposition of scene for irony, association by idea and character instead of time, and meaning through arrangement and focus instead of direct comment—all of which are outgrowths of the Impressionist's view of fictional structure.

It is through this general approach to the form of the novel that Conrad's techniques have had their most far-reaching effect, for much of the technical experimentation of the modern novel is an indirect or direct result of this basically new vision of the richness of meaning possible through form. 252 pages. \$3.25. Mic 56-2647

THE PORTRAIT OF THE BUSINESSMAN IN TWENTIETH CENTURY AMERICAN FICTION

(Publication No. 17,230)

Van Rensselaer Halsey, Jr., Ph.D.
University of Pennsylvania, 1956

Supervisor: Dr. Robert E. Spiller

This study has two basic purposes. The first is to describe the differences and similarities of the portrait of the businessman as found in three types of American literature (the stereotype or potboiler novels, the magazine fiction, and the novels which have won lasting critical acclaim) and to show the changes that have occurred from 1900 to the present. A second and more important purpose is to test the hypothesis that the so-called popular fiction of the past fifty-five years has more accuracy and is thus more valid for use as social document than are the critical novels which have received the attention of literary critics and historians.

All the business novels, and the business stories in the three most widely circulated magazines in four three-year periods (1900-1902, 1925-1927, 1933-1935, 1953-1955) form the basic material of the study. Through the use of some content analysis techniques, the focus is kept on the most common features of the fictional character. No attempt is made to analyze individual novels. Six categories, among them, factors in business achievement, motivation, and the relation of the individual to his business, are used throughout as a way of ordering and organizing the mate-

rial. After describing the fictional businessman, the portraits for each of the four periods are then compared with the most recent statistical and interpretive sociological studies of business and businessmen.

From this comparison it appears that, taken as groups of novels and stories, the popular fiction correlates more closely with the known facts than do the works of art. This is not to say that the popular fiction has always accurately reflected the business world, nor does this make it better literature. Both the popular writer and the critical novelist have fostered myths aplenty about the businessman. Unlike the popular writer, however, who seeks to satisfy a demand of the moment through a sentimental and often naive treatment of the more superficial aspects of life, the literary artist attempts to explore the inner meanings, the psychological and moral ramifications of experience. But because of his hostility toward business and his concern with the individual, he consistently presents a more biased and atypical concept of the businessman. This concept has been widely disseminated because the novels embodying this critical view rank among the best artistic works of American literature. 200 pages. \$2.60. Mic 56-2648

THE RAZON DE AMOR,
EDITION AND EVALUATION

(Publication No. 17,235)

Alfred B. Jacob, Ph.D.
University of Pennsylvania, 1956

Supervisor: Joseph E. Gillet

The *Razon* stands early in the history of Castilian lyrics, but its leading themes are found in prior and contemporary Latin, Arabic, French, Provençal and German literature, as well as subsequently in Italian. Such sources and analogues are here presented, particularly in five areas: the pastourelle, the courtly love lyric, the descriptions of classical and mediaeval gardens, the literary pattern of female beauty, and the mediaeval debates between Wine and Water.

In each area a conclusion may be drawn: that the *Razon* is in no sense a pastourelle, but has close affinity with some of the love poems of the Ripoll manuscripts; it belongs in a general way to the tradition of courtly love but deviates from many of its main features; it utilizes conventional descriptions of gardens and is closely allied with those of the vision literature of the Middle Ages; it adheres to the usual concept of female beauty except for the classical golden hair and the more intimate or suggestive details. The contest between Wine and Water builds on the Latin, but with notable psychological insight, and with a theological turn at the end.

The poem's uniqueness consists in its susceptibility of symbolic interpretation. Each of its principal constituents contributes to the story of man lost by the temptation in Eden and redeemed by the sacrifice of the Son of Mary on the Cross. In this way the mysteries of the narrative, such as the elevated cups of wine and enchanted water, can be seen as part of a meaningful whole consistent with the mind of the Middle Ages. The Debate, after providing some lighter fare, ends on the note of Salvation and so provides

the necessary clue to the earlier idyl. The variety within the poem does not mean that it is twofold except as this was part of the technique of a *juglar* within the course of a single presentation.

The Paris manuscript is reproduced photographically, transcribed, edited and translated. The edition includes the suggestions of earlier scholars and also proposes a convenient division into scenes and into stanzas of four verses for the narrative and six for the descriptive parts.

Included also are summaries of the principal articles written about the *Razon*, a note on its language and meter, a vocabulary of all words used with definitions and supplementary material where needed, an analytical index and a bibliography. 240 pages. \$3.10. Mic 56-2649

THE SOCIAL PROBLEM IN THE
WORK OF ANTON WILDGANS

(Publication No. 17,236)

Alexander Kallos Ph.D.
University of Pennsylvania, 1956

Supervisor: Dr. Adolf D. Klarmann

The work of Anton Wildgans has been characterized as expressionistic, semi-expressionistic, or naturalistic. A perusal of his treatment of the social problem, shows the inadequacy of these terms, as applied to Wildgans. A better designation may be metarealistic, since he is concerned with real social conditions, which he usually takes as his starting point, but from which he seeks a higher transcendental verity.

Wildgans always attached greater importance to the ethical content of a work of art, than to its formal perfection. This is particularly true about his plays. While *In Ewigkeit Amen* and *Armut* display an excellent grasp of the demands of the theatre, *Liebe*, *Dies Irae*, and *Kain* may be criticized for an over-abundance of sentimentality on one hand, and of lengthy philosophizing on the other. However, it cannot be denied that Wildgans' interest in social problems comes to the fore even in his less perfect plays. It is evident that he learned a great deal in this respect from Strindberg and Wedekind, in his early work also from Schnitzler.

For the social significance of his poems, Wildgans is mainly indebted to Baudelaire, secondarily to Rilke. His best social poems are to be found in the second section of *Buch der Gedichte*, entitled *Einsamkeit/Leid der Welt*.

The most powerful indictment of selfishness and indifference to human suffering is contained in the epic poem *Kirbisch*. This work may be Wildgans' finest creation, if judged by its success of synthesizing form and content.

Musik der Kindheit is primarily a book of nostalgia, with only occasional references to social problems. But *Anton Wildgans, Ein Leben in Briefen* contains many letters and essays of social interest, and thus, sheds a new light on the treatment of social problems in the works themselves.

Some of the important facets of Wildgans' preoccupation with the social problem are:

a) The question of material poverty, specifically among the lower middle classes, which Wildgans knew

well from his own experiences. He is less concerned with immediate social reforms that might alleviate this poverty, than with arousing the human conscience to a realization of what this social evil might do to the soul of the poor.

b) The plight of the outcasts of society. Here his experiences at the Court of Law, provided a strong stimulus for his creative ability and desire. Very often Wildgans pleads the case of the accused without due respect for the stability of society. He is the first to acknowledge this prejudice. He is particularly concerned with the question of "human" and "divine" justice.

c) The lack of compassion and charity, caused by man's sluggishness of the heart. This appears to be the underlying reason for many social ills.

d) The perpetuation of Original Sin. This problem troubled Wildgans throughout his own life. He sees the manifestation of the "Scourge of God" in contemporary social evils.

e) Among contemporary social problems the most poignantly treated are: The function of the courts of law in meting out justice; the impoverishment of the poor white-collar class; the disintegration of family life; the plight of the creative artist in a materialistic society; the oppressive atmosphere of the modern metropolis, and, perhaps most important, the mission of the civilized Austrian under the aspect of the frightening social conditions of the time, shortly after World War I.

Anton Wildgans exposes social ills ruthlessly, to the end that mankind may return to a realization of its responsibility. Wildgans, the truthful artist, only mirrors the strong sense of social concern of Wildgans, the man; his constant preoccupation with the social problem is not an artistic device, but an ethical imperative.

194 pages. \$2.55. Mic 56-2650

THE LIBERAL: 1822-1823

(Publication No. 17,250)

William Harvey Marshall, Ph.D.
University of Pennsylvania, 1956

Supervisor: Frederick L. Jones

The purpose of this dissertation has been to bring within a biographical and historical framework materials concerning The Liberal, the political and literary periodical sponsored by Lord Byron and edited by Leigh Hunt in Italy, and published by John Hunt in London in 1822 and 1823. These materials were found in the works about those who were directly or indirectly concerned with The Liberal, in the extensive contemporary comment which The Liberal drew from the press, and in various unpublished letters of Byron and the Hunts which are now in British and American libraries. These have enabled me to work out problems concerned with the authorship of the anonymous articles, financial arrangements, details of publication, and the course of public reaction to The Liberal.

Byron proposed the periodical, but Shelley developed the idea. However, Shelley's death removed whatever clear concept there might have been behind the work. Left alone, Byron and Hunt became progressively less capable of meeting the difficulties facing The Liberal. Each of Byron's

four close friends--Thomas Moore, John Cam Hobhouse, John Murray, Douglas Kinnaird--interfered in some way. The Tory press turned on The Liberal, first with anger but then with contempt, expressing judgments which were as personal as they were literary. The Examiner supported The Liberal, but the Whig press maintained silence. John Murray had temporarily withheld from John Hunt the Preface that Byron had written to "The Vision of Judgment," so that the Constitutional Association could bring about the indictment of John Hunt for libel of George III as publisher of the poem in the first number of The Liberal; a second edition containing the Preface did nothing to change the legal situation. Leigh Hunt wrote most of the first and much of the other numbers. Byron's loss of interest and the diminishing availability of materials by Shelley were somewhat offset in the three later numbers by contributions from Mary Shelley, William Hazlitt, Thomas Jefferson Hogg, Charles Armitage Brown, and Horace Smith. The Hunts paid quite well for these articles, perhaps adding to the causes of financial failure. Although the first number made a profit, the second showed a loss, and the profit of the third and fourth numbers, printed in limited quantity, was nominal. Hope for The Liberal declined after the second number and disappeared after the third. Before the fourth appeared, Byron had started for Greece, and Leigh Hunt had begun The Literary Examiner. John Hunt was convicted in January 1824 and sentenced to pay a nominal fine in June. After several years in Italy Leigh Hunt returned to England, where he wrote the record of his Italian experiences, Lord Byron and Some of His Contemporaries (1828).

As a financial venture and a personal experience The Liberal had been a failure. It brought forth some articles of literary value, particularly by those figures who were less well known, but much from Byron and Hunt that was of slight quality. But the episode remains significant in the history of English literature and of the political situation in which certain important literary figures moved in the early nineteenth century.

432 pages. \$5.50. Mic 56-2651

ATTITUDES OF AMERICANS IN FRANCE TOWARD CONTEMPORARY FRENCH POLITICAL LIFE, 1860-1914

(Publication No. 17,252)

Joel C. Mickelson, Ph.D.
University of Pennsylvania, 1956

Supervisor: Robert E. Spiller

This dissertation states what Americans who traveled or resided in France between 1860 and 1914 thought of contemporary French political life for the purpose of obtaining insight into the character and personality of this particular group of American citizens. By surveying their attitudes toward French political life, the study is intended to contribute to the cultural history of the period.

The Americans in question are those who wrote, or were written of, in relation to their sojourns in France. Personal writings proved to be the principal source of the study. The dissertation is presented in six chapters. The

first of two introductory chapters sketches French historical events in the period emphasizing those considered important by American observers. A second chapter portrays the socio-economic background of those observers. Their attitudes toward French political life are detailed in three subsequent chapters which consider their political attitudes toward French political life, their economic and social views, and their religious and ethical evaluations, under the three main historical divisions of the period: the later Second Empire (1860-1870); the Franco-Prussian War and Commune (1870-1871); and the early Third Republic (1871-1914). The final chapter draws conclusions as to the character and personality of the American in France between 1860 and 1914.

A major result of the research was evidence that the Americans in question came almost entirely from one class, the genteel class (primarily from the Eastern United States) which dominated American literary, art, social and to a large extent economic culture during the period. These people disapproved of French political life as they found it during the later Second Empire. They were particularly opposed to the political and personal ethics of the Emperor Napoleon III and his regime. Nevertheless many Americans in France could not resist entirely the glitter of the Empire and went to great lengths for even a brief glimpse of Napoleon III and the Empress Eugénie. But almost invariably the Americans' enthusiasm was accompanied by Republican reservations. During the period of the early Republic Americans in France continued to display the attitude of suspicion held over from the Bonapartist era and found much evidence which could be interpreted as showing that the French did not make acceptable democrats. In the years after 1870 they noted with dismay that the Church and the Royalist spirit still remained strong in French politics. The American view of French political-personal ethics continued doubtful in the period of adjustment between the aristocratic era and the firmly established French Republic, shortly after which it was jolted into alertness by the Panama Canal and Dreyfus scandals. The progress of the socio-economic thinking of the American in France with regard to French political life during the early Republic followed a different pattern from that of their political, and ethical-religious attitudes. This was a time when economic considerations were beginning to exercise a greater influence in American life than ever before. This process may be detected in the importance of economic incentives among the travelers considered in the study. With the advent of the Republic the attraction of American visitors for the now muted opulence of French life was expressed with greater approbation. Sometimes these visitors viewed the French as business competitors. A great number showed distaste and apprehension toward the French laboring class, which was very restless at the time. After the establishment of the Republic the manners of the French continued to call forth occasional negative ethical judgments from American observers. Shortly after the turn of the century the pattern of the attitudes of Americans in France toward French political life began to change very sharply. Visitors from the New World began to find France politically congenial since she was now wearing Republican garb convincingly. Thus between 1906 and 1914 the opinion of the American in France had moved all the way from political hostility toward the French (and a coincident affinity for France's enemy, Germany), to a eulogistic view of the French (and accompanying dislike for the

Germans). This period saw a belief in the improved ethical tone of French political life.

Conclusions concerning the character and personality of Americans in France between 1860 and 1914 as abstracted from their attitudes toward contemporary French political life are summarized in the last chapter of the dissertation. Republicanism more than anything else typified Americans in France who wrote, or were written of, in relation to their sojourns in that country during the period herein considered. Their Republicanism was moderate, and it was Protestant. Their political personality was also orderly, pacifistic, contented, yet at the same time somewhat brash, naive, and nationalistic. Economically speaking, these Americans displayed materialistic thinking, were industrious, and always overwhelmingly conservative. Their personalities were sometimes tinged with Puritanism: they could be prudish, or display a strongly developed guilt sense. They were often high-minded. These Americans occasionally indulged in romanticism, showing morbidity, a fondness for bathos, and excessive idealism, as manifested specifically in an unvarying optimism. Their compulsion to render service was evident in humanitarianism and reform efforts, as was their romantic chivalrousness.

170 pages. \$2.25. Mic 56-2652

THE POETRY OF JOHN BYRNE LEICESTER
WARREN, LORD DE TABLEY, EXCLUSIVE
OF THE DRAMAS

(Publication No. 17,264)

Gordon Marshall Pitts, Ph.D.
University of Pennsylvania, 1956

Supervisor: Dr. Morse Peckham

After a brief introduction in which I have pointed out the obscurity of Lord De Tabley and suggested some possible reasons for it, there follows a biography which shows something of the nature of the poet and his many interests.

The various volumes of verse are then taken up in chronological order, with some account in each case of the development of the poet's reputation as reflected in the reviews and notices.

The third chapter deals with the volumes issued under the pseudonym of "George F. Preston" (Poems, Ballads and Metrical Sketches, and Glimpses of Antiquity), pointing out the weaknesses of De Tabley's early work, his tendency to imitate, and his dependence upon certain rigid literary styles. I have tried here to indicate certain foreshadowings of the great dramatic pieces which were to come.

The fourth chapter deals with the work of "William Lancaster" (Praeterita, Eclogues and Monodramas, and Studies in Verse), showing the development of a more individual style, although there are echoes of Keats, Tennyson, and other writers. After a brief consideration of the despondent love lyrics in Eclogues and Monodramas and Studies in Verse, I have discussed the dramatic poems in these two volumes, with special emphasis on the poet's individual treatment of classical and English idyllic narrative themes.

The fifth chapter, after a brief discussion of the plays *Philoctetes* and *Orestes* and their place in De Tabley's philosophy, shows how the poet, at the height of his powers, in *Rehearsals* and *Searching the Net*, is gaining more and more skill in the presentation of dramatic monologues which show a character in action.

The sixth chapter deals with the poet's re-appearance in 1893 after a silence of seventeen years, with *Poems Dramatic and Lyrical*, which contains a gleanings of some of his earlier poems, and a number of new pieces. The new pieces are discussed and analysed as examples of De Tabley's further poetic development.

The seventh and eighth chapters deal with *Poems Dramatic and Lyrical: Second Series* (1895) and the posthumous *Orpheus in Thrace* of 1901, showing particularly how the poet's power of description and his dramatic ability have advanced in such poems as "The Death of Phaethon," "Orpheus in Thrace," and "A Daughter of Circe."

Throughout the study I have tried to give some account of the poet's development in the field of the lyric, which, while it was not as great as his dramatic progress, shows some advance, particularly towards the end of his life. Throughout I have also tried to indicate how De Tabley as a botanist has been able to evolve a fresh and individual imagery in his use of plants, flowers, and other natural objects.

In conclusion, I have tried to demonstrate that most of De Tabley's better and most original poems, "The Strange Parable," "Jael," and others, show us that the key to an understanding of De Tabley's poetry is the realization that he is the poet of frustration and that he explores the various moods and emotions generated by frustration to an extent which, as far as I know, no other English poet has done.

283 pages. \$3.65. Mic 56-2653

THE SEARCH FOR THOMAS WOLFE:
WITH PARTICULAR STRESS UPON THE
MEANING OF THE AMATORY THEME

(Publication No. 17,279)

Harry D. Sprowles Jr., Ph.D.
University of Pennsylvania, 1956

Supervisor: Professor Thomas P. Haviland

The basic thesis of this dissertation is that the autobiographical writings of Thomas Wolfe are revealing of the author's search for his own true self. Keynoted by the familiar Arnold poem "The Buried Life," the dissertation examines six facets of its thesis--his desire in his early years for recognition as an individual, the Faustian search for all knowledge and for worldly experience, the search for a father, the search for fame and fortune, the search for a home, and the search for love.

As with many another man in many an age, Wolfe was troubled by subterranean hints of his true self, buried as it was from tangible or visible contact. Bewilderment, uncertainty, anxiety, terror, rage, panic,--each of these emotions fastened its grip upon him as he turned wildly from person to person, place to place, distraction to distraction, in the search for himself. These six facets are convenient labels because in these six ways he deluded

himself as to the true goal he was seeking. He assured himself he wanted worldly experience and Faustian omniscience, that fame was his goal, that he sought a spiritual Father, that he would be at rest if only he could find a place, a home, that romantic love of a woman and for a woman would be his lane into Paradise. Each of these he pursued and then, finding each insufficient, circled distractedly around again like the squirrel in a revolving cage or the dog that chases its own tail.

But all the while, he knew subconsciously that it was for himself he was seeking and, at times, consciously realized the true goal he longed for. He was striving to believe himself to be like all other men even while knowing that we are strangers to one another and to ourselves, that each of us is One fundamentally opposed to the Others who surround us. Although he was obsessed with the sense of being a Gulliver among alien Lilliputians, we can see that Wolfe was no different from each of us who are visited by the same desires and longings. Few of us have experienced these longings to so extreme a degree as Wolfe did and fewer have written so tellingly of the struggle.

166 pages. \$2.20. Mic 56-2654

A SURVEY OF SIXTEENTH-CENTURY
ENGLISH RELIGIOUS VERSE

(Publication No. 17,284)

Robert B. Thornburg, Ph.D.
University of Pennsylvania, 1956

Supervisor: Professor M. A. Shaaber

The dissertation attempts a descriptive and critical survey of the verse of direct religious relevance produced or circulated in England in the sixteenth century. An effort has been made to include all such verse printed during the century of which copies are extant except writing of a patently occasional nature with little spiritual or literary significance. Some manuscript verse which has been published since 1600 is considered, but no attention is given to unpublished manuscripts. Emphasis is placed upon the classification of the verse in relation to the complex developments in religion and in poetry which marked the period and upon the analysis and evaluation of some examples of the verse of each type that are of particular religious or literary interest or that are typical of their class. In addition to interpreting the verse in terms of the literary and religious situation in which it appeared, the essay strives to evaluate it by criteria for religious verse which have (it is hoped) some present-day or even permanent validity.

After a preliminary discussion of attitudes toward and theories of religious verse in sixteenth-century England, successive chapters treat (1) religious carols, (2) versified saints' lives, (3) verse of religious controversy, (4) verse of religio-moral exhortation, (5) verse of doctrinal instruction, (6) metrical Scripture, and (7) devotional and meditative verse.

Besides justifying their writings as works for their own edification or as intended means of edifying readers, Christian versifiers of almost every religious position throughout the century also defended their compositions

against the persistent allegedly religious opposition to poetry by asserting that religious verse was (1) an antidote for lascivious poetry, or (2) a vehicle for truth in contradistinction to the lies and feigning of secular verse, or (3) divinely inspired utterance. Whereas the first two of these defenses stressed content to the neglect of poetical form, the third--vigorously enunciated by Skelton and more thoughtfully developed by Lodge, Sidney, Puttenham, and others--focused attention on form as well as content and effected a kind of sanctification of the aesthetic impulse. Thus the conscious cultivation of poetic values in religious verse was encouraged.

Such a development is discernible through the century in every type of religious verse except in the carols, which represent the decline of a medieval tradition of spontaneous religious lyricism. Some sixteenth-century carols, however, illuminate theological principles through an imaginative fusion of human and divine elements.

Polemical verse also clung to conventional forms of allegory and dialogue throughout the century, but there were advances in verisimilitude and personal interest in some of the satires. Verse of religio-moral exhortation tended to be undistinguished. Emphasis on the human to the neglect of the divine in poems of both of these classes limited their spiritual value just as a generally direct and unimaginative approach diminished their literary effectiveness.

Contrariwise, the verse aimed at doctrinal instruction and a good deal of the abundant metrical translation of Scripture exhibit a lack of human relevance through excessive concentration on their supposedly divine content. There were, however, throughout the century, poems on scriptural themes in which freely imaginative treatment led to poetry of literary and spiritual worth.

Devotional verse ranged from dull and conventional ready-made prayers to meditative pieces, like those of Breton and Southwell, which integrated the human and the divine elements and gave immediate personal meaning to biblical and traditional material. Thus by the end of the century, conscious art and devotion had in a sense restored the balance which had vitalized the best of the carols. Conditions were ripe for the flowering of religious poetry which was to come in the next century.

813 pages. \$10.30. Mic 56-2655

CLAUDEL AND THE CITY OF MEN

(Publication No. 17,150)

Harold Arthur Waters, Ph.D.
University of Washington, 1956

Claudel greatly emphasized worldly society, his only greater preoccupation being God. He viewed the Middle Ages as the time when Europe's existence had been closest to the sacral state he favored. Since then, he considered that various factors had contributed to deter men from the idea of communal existence in consciousness of God, though he acknowledged that the Renaissance had served to help men realize God's wonder. The most godless period, he believed, was the nineteenth century, but since then he detected and welcomed a religious revival.

Claudel found that godlessness perpetrates immorality

and pessimism, injures existence by its relative inability to inspire sensitivity or suggest worthy goals, and has mediocrity as its frequent corollary. Godliness, he believed, sensitizes and invigorates men, and inspires healthy morality.

Claudel long despised science, since scientism had made a god of it. Science, in his opinion, often led to only a material view of life. Consequently, Claudel attacked science, until he realized it can be considered separately from scientism and can help illustrate the glory of God. He thus came to admit the practical efficacy of some changes, and his complaints against obviously unpleasant aspects of modern civilization then seemed more impartial.

Claudel favored a close-knit, patriarchal family structure, in which man signifies God's preeminence, and woman is a symbol of the love one should extend to God and His creation. Part of individual security, he felt, should also derive from communion among all the world's families. Claudel yearned for the day when the world would act communally under God's aegis.

He favored ownership. Through ownership, he believed, men can express their love for God--by extending God's wonder--and fellow men--by its considerate management. While warning against complete materialism, Claudel found in ownership another advantage: it lends stability to men's earthly actions.

Though calling negative the justice that protects property, Claudel supported it, providing men also obey positive justice: charity, or the idea that men owe everything to everyone.

Opposed to violent change, Claudel believed in conservative government, and that a state should subordinate itself to an established church, from whose accumulated wisdom it could profit. He preferred a hierarchic system, decentralized to permit warm, close contact among its members. He believed godliness, integrity, and economical advantages would derive from such a system. All should be conscious of their role in government, and a government should endure by persuasion of its rightness rather than by force. Claudel furthermore preferred a religious monarchy.

He believed a state should permit its educators to speak of God, and from this they themselves would gain valuable insights. Claudel being against force, it is likely he preferred subsidization of non-religious and religious schools.

There is evidence to the effect that Claudel saw France as a nation newly chosen by God to lead the world to salvation. His reasons were France's intellectual and spiritual gifts.

When Claudel spoke of religion, he usually had Catholicism in mind. This would separate non-Catholics from his message, were it not that if his message is desacralized--i.e., his emphasis upon the sacral life removed--much valid advice remains. His optimism about man is encouraging, and his ideas on family, charity, decentralized government, his warnings against materialism, are worthy of study. It is important to realize that Claudel was primarily occupied with the mental health of the ideal social man. After this came his interest in the physical details of existence.

196 pages. \$2.55. Mic 56-2656

THE DEATH PROBLEM IN THE WORKS OF ERNST WIECHERT

(Publication No. 17,285)

Adolph H. Wegener, Ph.D.
University of Pennsylvania, 1956

Supervisor: Professor Adolf D. Klarmann

The purpose of this study is to explore and substantiate the causes of death, the various reactions, reflections, concepts, aspects, functions and appearances of death in Ernst Wiechert's works.

Chapter I considers the pertinence of the literary configuration of Wiechert's time which influenced directly and indirectly his thoughts about death and imparted a particular tenor to his creative efforts. With Wiechert's autobiographical works as a basis, Chapter II gives an appraisal of Wiechert's personal reactions to death, the impact of his experiences with death, and the effects and reactions that coalesced in the formulation of his concept. Chapter III, entitled "Death as Escape", stresses the aspect of suicide as the only route left open to the individual to flee from an intolerable life situation in the face of overwhelming odds. In Chapter IV, "Death as Sacrifice", the fundamental principle of giving life to promote or preserve life incident to science, society, justice, religion and personal convictions, is emphasized. It illustrates Wiechert's concept that man must always stand ready to lay down his life for what he believes to be the true and the good. The longest discussion of the problem is found in Chapter V, entitled "Death in War", which depicts the meaningless death of the soldier on the battlefield and the lurid details of the physical and spiritual ravages of war. The aspect of dying for the cult of *mater dolorosa* and the victory over death by enduring love and new life is shown as the motivating force to conquer the surge of death. The concepts of conscience and guilt, sin and atonement, fate and punishment are emphasized in Chapter VI, "Death as Judgement", and illustrate how man, by overstepping the moral law, temporarily destroys the humanity within himself, but through self-realization of his transgression is transformed and ennobled, ready to continue in life or death. In the final chapter, "Death in Nature", the author shows how Wiechert's nature is permeated by and exposed to death in its struggle for existence in preserving an unalterable law against man's encroachments.

Ernst Wiechert considers death inherent in an implied order of a harmonious universe and stresses the individual's right to seek his own death. Wiechert's meditations upon death do not lead to any doctrines of palingenesis, transfiguration or the physical resurrection of the body, nor does he render allegiance to the idea that death is synonymous with immortality. He believes the democracy of death cannot be defeated, for death is the cruel and overpowering marauder who relentlessly steals away life and man is helpless in making some sort of united front against its depredations. It is in this life that Wiechert realizes an immortality. He regards death as the unknown, the absolute end of the individual conscious personality. Death in some instances is conceived as a cause of rebirth, which symbolizes fundamental inner changes in the individual. There are few cases where death comes as a blessed relief, but Wiechert does not indulge in metaphysical descriptions of its soothing quality; for death is no

respector of life. Wiechert's answer to death's call is to envisage those enduring qualities of love and fraternity which outlive the brevities and vicissitudes of earthly existence.

155 pages. \$2.05. Mic 56-2657

THE SYMBOLISM OF COLOR IN THE DRAMA OF GERMAN EXPRESSIONISM

(Publication No. 17,497)

R C Wyatt, Ph.D.
State University of Iowa, 1956

Chairman: Professor Erich Funke

The purpose of this dissertation was to examine the use of color in certain representative dramas in the period of Expressionism, and to determine what significance these colors had in the emotional and esthetic values of these specific dramas, and to what extent color is characteristic of the period as a whole. Ten dramas representing eight authors covering the period from 1891 (1906), the beginning of the transition, to 1920 were examined. A consistent effort was made to choose plays from the most outstanding Expressionists and to select those plays which are representative of the playwrights' best efforts and are thoroughly a part of the living stage. For the last chapter, one exception was made in the choice of Kandinsky's *Der gelbe Klang*, which is typical of the Expressionists' theory of color. The other plays used in this dissertation are these: Hofmannsthal's *Elektra*; Wedekind's *Frühlings Erwachen*; Sorge's *Der Bettler*; Unruh's *Ein Geschlecht*; Kaiser's *Die Kralle*, *Gas I*, *Gas II*; Goering's *Seeschlacht*; Toller's *Masse Mensch*.

The amount of color within these plays sufficiently proved the validity of examining them from this viewpoint. Charts were carefully prepared showing the color-words and frequency of appearances per author and play. All significant color references were discussed as to contextual usage and symbolism with cross references and comparisons between these ten plays.

The plethora of color usages pointed to the significance of color. The study of specific uses of it proved effective in establishing certain patterns with regard to the period. Almost all chromatic and achromatic colors, with the exception of orange, were used. Definite preferences were evidenced for bright, vital, importunate hues. The Expressionists might be characterized by one color -- the regnant red, since it led all the rest in frequency of use. Green was the second most used color, while third and fourth place go respectively to the achromatic black and white. Blue was fifth in preference, followed by yellow, gray, and gold in that order. Other colors which appeared but relatively rarely were purple, violet, brown, pink, and various combinations such as red-yellow and gray-green.

The fewest colors appeared in *Seeschlacht* with only blue and white important in its symbolism. *Der gelbe Klang* had the widest variety of colors, totaling 21.

All colors have both positive and negative values, and all colors used in these plays were used in both ways. In *Elektra* red symbolized madness, hate, love, royalty, and anger. In *Der Bettler* it represented madness to the exclusion of almost all else. In *Die Kralle* it symbolized a

much-desired goal, while Unruh and Toller used it to mean revolution and bloodshed. In Gas I and Gas II it was the color of violence and destruction.

Goering used blue in a negative quality to represent madness, in its positive quality as peace. White was often a negative symbol as it was one of good. In Die Koralle white represented (for Kaiser) the undesirable, privileged few (capitalism) and in Gas I it became even more negative in the "white terror."

Green is sometimes a symbol of the undesirable, par-

ticularly in Masse Mensch, and Ein Geschlecht; it is more often representative of good or hope (i.e., in the Gas trilogy, in Der Bettler, and in Ein Geschlecht).

Black was used fairly consistently to portray negative qualities such as evil, mourning, pain; but it occasionally appeared in a positive value such as peaceful sleep and quiet.

Gold and pink, among the favorite colors of past ages, are seldom used by the Expressionists; and when gold does appear it is more often in a negative than positive sense.

194 pages. \$2.55. Mic 56-2658

LIBRARY SCIENCE

A STUDY OF THE PROBLEM OF COMPLETE DOCUMENTATION IN SCIENCE AND TECHNOLOGY

(Publication No. 18,152)

Ralph Harvey Hopp, Ph.D.
University of Illinois, 1956

This study has as its objective the analysis of the periodical literature of pure science to determine the degree to which references on a subject are dispersed throughout a large number of periodicals. It also seeks to determine the extent to which such references are concentrated within a nucleus of a comparatively few titles.

Although various methods have been used for the analysis of scientific periodical literature--most of them centering around citation analysis techniques--each of the methods did not appear to identify adequately a representative body of literature for a particular subject. For the purposes of this investigation, comprehensive bibliographies of four subjects in pure science--one each in chemistry, mathematics, biology, and physics--were chosen which qualified as being descriptive of the extent and nature of the literature of the subjects covered. The references in each bibliography were analyzed and the periodical titles, and the dates of their publication, were noted. From these analyses the characteristics of scattering and concentration of the literature was observed. These characteristics were also noted as they varied with the date of publication or the state of development of the respective subjects.

In each case it was found that the literature of the various subjects contained references to a large number of periodicals. In mathematics the number of periodicals that were cited only once accounted for 29.6 per cent of the total, while in the other three subjects--physics, biology, and chemistry--the number ranged from 50.7 to 58.8 per cent of the total. The percentage of titles that were cited four times or less ranged from 53.4, for mathematics, to 86.1 for physics.

One explanation for this widespread scattering of scientific literature is the fact that there are, in all sciences, areas of mutual interest to other sciences, and these interrelationships are reflected in the literature of any scientific subject. This scattering emphasizes the problems

faced by those libraries attempting to acquire relatively comprehensive collections in any particular area. It also shows the difficulties encountered by indexing and abstracting services in their effort to provide substantially complete coverage of the literature on a subject. In the chemistry bibliography, for example, 428 different periodicals were cited; of these, 217--approximately one-half of the total--contained only one reference each on the subject, yielding a total of only 8.3 per cent of all the references.

In contrast to this widespread dispersion of the literature it was found that a considerable proportion of the references in each bibliography was concentrated within a few key periodicals. Between 8.5 and 11.7 per cent of the references were produced by one periodical. Five per cent of the periodicals in the bibliographies studied produced 36 to 58 per cent of the references. Ten per cent produced 52 to 68 per cent, and twenty-five per cent of the periodicals produced 77 to 82 per cent of the total number of references.

These findings indicate that a science library need not subscribe to a great many periodicals to obtain relatively good coverage of the literature, if its holdings are carefully selected. In chemistry, for example, this study shows that fifty per cent of all references will be produced by about three per cent of the periodicals pertaining to chemistry.

In analyzing the four bibliographies used in this study it was found that there is no apparent correlation between general distribution patterns of scientific periodical references and the dates of those references, or the state of development of the subject. The continued growth of a special subject library in science will be dependent upon, and in some proportion to, the volume of literature of the subject. This growth, however, is not likely to be affected to any great extent by the dispersion of the literature which may result from either the wider application of the subject or the number of periodicals published. Therefore, the increase in size of such libraries will probably be arithmetical in character rather than exponential.

129 pages. \$1.75. Mic 56-2659

MATHEMATICS

TOPOLOGICAL LATTICES

(Publication No. 17,017)

Lee William Anderson, Ph.D.
Tulane University, 1956

Chairman: A. D. Wallace

We will agree that a topological lattice is a Hausdorff space together with a pair of continuous functions $\wedge: L \times L \rightarrow L$ and $\vee: L \times L \rightarrow L$ which satisfy the usual conditions stipulated for a lattice. Hereafter, unless the contrary is explicitly stated, L will denote a connected topological lattice.

Some of the basic definitions and elementary properties of a topological lattice are discussed in section II. In addition, several fundamental structure theorems are proved. Among them is the result: for any a in L , $F(a \wedge L)$, the boundary of $a \wedge L$, is connected; $a \wedge (L \setminus (a \wedge L)) \subset F(a \wedge L)$; $F(a \wedge L) = F(a \wedge L) \vee (a \wedge L)$ and dually. It is also shown that if A is an open (respectively, compact) subset of L (where L need not be connected) then $A \wedge L$ and $A \vee L$ are open (respectively, closed).

In section III we indicate the role played by cutpoints in a topological lattice. This is demonstrated by the theorem: a necessary and sufficient condition that an element of L cut L is that it be order related to every element of L but distinct from 0 and 1. In addition, it is shown that the complement of any element of L contains at most two components. It follows from these basic results that if L contains a 0 and a 1 then L is a chain (i.e., linearly ordered) if, and only if, L is irreducibly connected about 0 and 1. Another consequence of these results is that L admits at most two end points. Finally, it is shown that if L is a chain then \wedge and \vee are the only functions which make L a topological lattice.

The property of local convexity in a topological lattice is investigated in section IV. It is shown that if L is locally compact, it is locally convex, and that if L is locally convex then it is locally connected. It follows from this that a locally compact connected separable metrizable topological lattice is a Peano space. It is also shown that if L is a locally convex chain then the topology in L is equivalent to the intrinsic topology.

In section V, we investigate some of the connections between the dimension of a topological lattice and its lattice theoretic properties. One-dimensional lattices are characterized as follows: if L is locally compact then L is a chain if, and only if, L is one-dimensional. In the case that L is a locally compact subset of the Euclidean plane, it is shown that L is a distributive lattice and a simply connected subset of the plane. Among the numerous lemmas needed to prove this result is the lemma: if L is a locally compact subset of the Euclidean plane and if C is a compact subset of L then C is bounded above and below.

63 pages. \$1.50. Mic 56-2660

CAUCHY TYPE REPRESENTATIONS FOR FUNCTIONS OF A COMPLEX VARIABLE

(Publication No. 18,111)

Richard Solomon Ballance, Ph.D.
University of Illinois, 1956

This thesis consists of a collection of theorems giving conditions under which functions of a complex variable are representable in the form

$$f(z) = \frac{-1}{2\pi i} \iint_G \frac{\phi(\zeta)}{\zeta - z} dJ_1 d\zeta_2 + h(z)$$

where $h(z)$ is to be analytic, $\zeta = \zeta_1 + i\zeta_2$, and $\phi(\zeta)$ is either the ordinary derivative of $F(I) = \int_{(I)} f(z) dz$ or the derivative with respect to a binary sequence of nets ((I) is the boundary of an interval I in the complex plane.).

The proofs of the theorems follow, in general, this pattern: One forms

$$\int_{(I)} h(z) dz = \int_{(I)} f(z) dz + \int_{(I)} \frac{1}{2\pi i} \iint_G \frac{\phi(\zeta)}{\zeta - z} dJ_1 d\zeta_2 dz$$

and shows that under certain conditions concerning essentially the measure of the set upon which $\lim |F(I)|/|I|$ as $I \rightarrow z$ is bounded by some function of n : 1. one can invert the order of integration above, obtaining

$$\int_{(I)} h(z) dz = F(I) - \iint_I \phi(\zeta) d\zeta_1 d\zeta_2$$

2. use the well-known theorems of Ridder or Besicovitch to show

$$F(I) = \iint_I \phi(\zeta) d\zeta_1 d\zeta_2$$

3. the integral in the representation is continuous, and hence by Morera's theorem the desired result is obtained.

46 pages. \$1.50. Mic 56-2661

AN EXTENDED MARKOV PROPERTY

(Publication No. 18,294)

Robert McCallum Blumenthal, Ph.D.
Cornell University, 1956

Throughout, $\{x(t); t \geq 0\}$ is a time homogeneous Markov process defined over a probability space (Ω, \mathcal{B}, P) and taking values in a metric space X . $P(t, x, A)$ is the transition function of the process. Let T be a positive random variable and consider the process $\{x(t+T); t \geq 0\}$. T is called a Markov time for the original process if $\{x(t+T)\}$ is a Markov process with $P(t, x, A)$ as transition

function and if the new process is conditionally independent (relative to $x(T)$ being given) of the original process considered only for values of $t \leq T$. Let $\mathcal{F}(b)$ be the smallest subfield of \mathcal{B} with respect to which $x(t)$ is measurable for each t not exceeding b . T is called a stopping time if there is a Borel field \mathcal{H} which for every b is independent of $\mathcal{F}(b)$ and is such that for every non-negative a , $\{T \leq a\}$ is an element of the Borel field generated by $\mathcal{F}(a)$ and \mathcal{H} .

1. Lemma 1.1. Any countably valued stopping time is a Markov time.

Theorem 1.1. Suppose T is a stopping time and for each t , $x(s+t+T) \rightarrow x(t+T)$ with probability 1 as s decreases to 0. Then T is a Markov time provided that

$$(D) \int_x \phi(y) P(t, x, dy) \text{ is continuous in } x \text{ whenever } \phi$$

is a bounded continuous function on X .

From theorem 1.1 we obtain a

Zero-one law. Suppose $\{x(t)\}$ has right continuous sample functions, that $x(0)$ is constant with probability 1, and that (D) holds. Then if Δ is in $\mathcal{H}(\delta)$ for every $\delta > 0$ we have either $P(\Delta) = 0$ or $P(\Delta) = 1$.

Examples show that neither the condition that $x(s+t+T) \rightarrow x(t+T)$ nor condition (D) can be eliminated from the hypotheses of theorem 1.1.

2. From now on we assume that X is separable and locally compact and that $\{x(t)\}$ is separable. We first list the following conditions for later reference:

(E) For every $\delta > 0$ and compact subset C of X there is a $K(\delta, C)$ such that $P(t, x, I_x(\delta)) \geq 1 - Kt$ for every $t \geq 0$ and x in C (where $I_x(\delta) = \{y \in X \mid \rho(x, y) < \delta\}$. ρ is any fixed metric on X).

(E') For every $\delta > 0$ and compact set C , $P(t, x, I_x(\delta)) \rightarrow 1$ uniformly in C as $t \rightarrow 0$.

(E'') For every $\delta > 0$ and x in X , $P(t, x, I_x(\delta)) \rightarrow 1$ as $t \rightarrow 0$.

(F) There is an $r > 0$ such that given any compact set C and any $\delta > 0$ there is a compact set $D(C, \delta)$ such that $\sup_{t \leq r, x \in D} P(t, x, C) < \delta$.

(G) Almost all sample functions have left hand and right hand limits at every value of t .

(G') For each t , $\lim_{s \uparrow t} x(s)$ and $\lim_{s \downarrow t} x(s)$ exist with probability 1.

Theorem 2.1. Under condition (F) almost all sample functions are bounded on any finite t interval.

Theorem 2.2. If conditions (E') and (F) hold then (G) holds.

Theorem 2.3. If (D), (E''), and (G') hold then $\{x(t)\}$ has no stationary discontinuities.

If X is compact then (F) is eliminated from the hypotheses of theorems 2.1 and 2.2 and the conclusions remain valid.

3. Theorem 3.1. Suppose $\{x(t)\}$ is separable and (D), (E'), and (F) hold. Suppose $\{T_n\}$ is an increasing sequence of stopping times and that $T_n < T$ and $\lim T_n = T$ with probability 1. Then T is a Markov time.

4. Theorem 4.1. Suppose almost all sample functions of $\{x(t)\}$ are right continuous and (D) and (E) hold. Suppose

T is the limit of an increasing sequence $\{T_n\}$ of stopping times and that for every $\delta > 0$ there is a compact set $C(\delta)$ such that $P\{x(T_n) \notin C\} < \delta$ for every n . Then $\lim x(T_n) = x(T)$ with probability 1.

Theorem 4.2. If (D), (E''), and (G) hold and T is the limit of an increasing sequence $\{T_n\}$ of stopping times then $\lim x(T_n) = x(T)$ with probability 1.

42 pages. \$1.50. Mic 56-2662

GROUPS, ALL OF WHOSE PARTIAL ENDOMORPHISMS ARE EXTENDABLE

(Publication No. 18, 116)

Kenneth Allyn Brons, Ph.D.
University of Illinois, 1956

A homomorphism of a subgroup of the group G into G is termed a partial endomorphism of G . It is the purpose of this paper to characterize all finite groups G with the property:

H) Every partial endomorphism of G is induced by an endomorphism of G .

This goal is achieved in the Main Theorem, for whose statement it will be convenient to introduce the following terminology. Throughout this paper the word group shall mean finite group. If a group G is the quaternion group of eight elements, we shall say simply that G is quaternion. We term regular abelian any direct product of isomorphic cyclic groups. The letters p and q shall always denote primes, and $G(p)$ the set of elements x of G such that each prime divisor of the order of x is equal to or greater than p . The symbol p' shall always denote the least prime greater than p , so that clearly $G(p') \leq G(p)$. Note that $G = G(2)$. If S and T are subsets of a group, then the set of elements in T which commute with all elements of S is called the centralizer of S in T .

MAIN THEOREM: Every partial endomorphism of the finite group G is induced by an endomorphism of G if, and only if, G satisfies the following conditions:

- 1) Every $G(p)$ is a group.
- 2) $G(p)/G(p')$ is either regular abelian or quaternion.
- 3) For every prime $p \neq 2$ and each element g in $G/G(p')$, there exists an integer $i = i(g)$ such that $g^{-1}xg = g^i$ for all elements x in $G(p)/G(p')$.
- 4) If S is a subgroup of $G(p')$ and if W is the centralizer of S in $G(p)$, then $G(p')W/G(p')$ is a direct factor of $G(p)/G(p')$.
- 5) Either $G(p')$ is a direct factor of $G(p)$, or $G(p)/G(p')$ is contained in the center of $G/G(p')$.

Remark: It is shown that the conditions of the theorem imply supersolubility of G and that if the quaternion group is a subgroup of G , then it is a direct factor of G .

33 pages. \$1.50. Mic 56-2663

MOSAICS

(Publication No. 17,605)

Walter Francis Davison, Ph.D.
University of Virginia, 1956

The primary objectives are (i) to obtain and investigate a means of generating a topology from a collection of curves and (ii) to demonstrate that Fréchet equivalence is meaningful within this context. In order to eliminate pathological collections of curves a compatibility condition is assumed throughout, and there consequently arises the basic mathematical structure, a mosaic. By definition a mosaic is a collection of triplets $[(X_a, T_a, f_a): a \in A]$ such that (i) each (X_a, T_a) is a topological space, (ii) each f_a is a function defined on X_a , and (iii) the following compatibility condition holds: for each $a, a' \in A$ if $E \subset X_a$ is T_a -closed then $f_a^{-1}f_{a'}(E)$ is $T_{a'}$ -closed. On the range set $X = \cup [f_a(X_a): a \in A]$ the mosaic topology T is defined as follows: for all $E \subset X$, E is T -closed if and only if $f_a^{-1}(E)$ is T_a -closed for all $a \in A$.

In section 1, General Mosaics, a preliminary investigation is made without any restrictions on the topological spaces (X_a, T_a) , including enough material to show that the study of mosaics with a finite number of triplets is similar to the study of closed, continuous functions.

Section 2, Convergent Sequences and Topological Spaces, explicates some standard material on the connections between topological spaces and sequence convergence classes.

In section 3, Mosaics of Compact Metric Spaces, each space (X_a, T_a) of the mosaic $[(X_a, T_a, f_a): a \in A]$ is assumed to be compact metric, and the properties of the mosaic space (X, T) are investigated. The principal result is that a topology T on a set X is the mosaic topology of some mosaic of compact metric spaces if and only if (i) T -convergent sequences have unique limits and (ii) for every $E \subset X$ if E is closed for the T -convergent sequences then E is T -closed. Among other properties we find that a mosaic space need not be Hausdorff but that it has the property that every compact set is closed. A characterization is obtained for those mosaic spaces for which every subspace is a mosaic space.

Next the spaces (X_a, T_a) are specialized to Peano spaces in section 4, Mosaics of Curves and Arcs. The ensuing curve spaces (X, T) may be characterized as spaces which have properties (i) and (ii) above and the property (iii) that for every sequence S in X if S converges (T) to some x then there exists a subsequence S' of S and a curve Y in X such that the point set of S is in Y . Connectedness properties of the spaces (X_a, T_a) are shown to carry over to (X, T) . Similarly mosaics of arcs are considered, culminating in a characterization of strong arcwise connectedness.

For a class of compatible functions on a compact Hausdorff space (X_0, T_0) a means is found in section 5, Compact Hausdorff Varieties, for expressing an equivalence relation F for these functions in terms of the unique uniformity U_0 of (X_0, T_0) . Then the class of continuous functions from a compact Hausdorff space into a topological space with the property that every compact set is closed is shown to be compatible, so that F is meaningful in this context. Therefore F is applicable to mosaic spaces, curve spaces, and arc spaces. Finally F is shown to agree with Fréchet equivalence within the context for

which the latter is defined.

Given a curve space (X, T) it is possible to endow X^I , the space of all continuous functions from the unit interval I into (X, T) , with the compact-open topology T_{CO} , a mosaic topology T_M , and a curve topology such that

$$T_{CO} \subset T_M \subset T_C,$$

wherein the inclusions are in general proper. Section 6, A Higher Curve Space, investigates this situation and terminates with a demonstration that the quotient space $(X^I/F, T_Q)$ of (X^I, T_C) under F is again a curve space.

97 pages. \$1.50. Mic 56-2664

UNBIASED ESTIMATION AND ADMISSIBILITY
AND THE TREATMENT OF TIES IN THE SIGN TEST

(Publication No. 18,133)

Alvin Vincent Fend, Ph.D.
University of Illinois, 1956

If a variable X has density function $f(x, \theta)$, then in many cases the Cramér-Rao bound or the Bhattacharyya bounds may be used to show that a function $d(x)$ is a uniformly minimum variance unbiased estimate of the real parameter θ . Recently Hodges and Lehmann [Proceedings of the Second Berkeley Symposium on Mathematical Statistics and Probability, University of California Press, 1951, pp. 13-22] introduced a method for proving admissibility using the Cramér-Rao inequality.

In this paper it is shown that if the variance of $d(x)$ achieves the k -th Bhattacharyya bound, but not the $(k-1)$ -th bound, then, under certain restrictions, the density function is of the form $f(x, \theta) = \exp [t(x)g(\theta) + g_0(\theta) + h(x)]$ and $d(x)$ is a polynomial in $t(x)$ of degree k . Further, the variance of any polynomial in $t(x)$ of degree k will achieve the k -th bound, so that if any such unbiased polynomial exists, it will necessarily be uniformly minimum variance unbiased. Some properties of these polynomial estimates are discussed, including a connection with maximum likelihood estimates. In addition, the method of Hodges and Lehmann is extended to the Bhattacharyya bounds and some general theorems on admissibility are proved. In particular, conditions are given under which bounded risk estimates or best invariant estimates are admissible under a squared error risk function.

The second part of the paper is concerned with the sign test. This non-parametric test is often used under the assumption that the random variables involved are continuous, and in this case ties, or zero differences, may be ignored. However, in practice the assumption is not reasonable, and ties do occur with positive probability. In the analysis presented here, ties are treated as random variables and the uniformly most powerful unbiased test based on the number of ties and the number of positive differences is found for the two-sided alternative. The power function of this best unbiased test is compared with the power function of a test defined by Dixon and Mood [Journal of the American Statistical Association, Vol. 41 (1946), pp. 557-566], and conditions are given under which the latter test is inadmissible.

65 pages. \$1.50. Mic 56-2665

ON THE ERGODIC THEOREM IN DYNAMICAL SYSTEMS WITH VARIANT MEASURE

(Publication No. 18,136)

Aubyn Freed, Ph.D.
University of Illinois, 1956

Since Birkhoff's proof of the ergodic theorem in the case where a measure-preserving transformation $f(p,t): G \rightarrow G$ is defined in a space G of finite measure, a number of generalizations and refinements have come forth. Those relaxing the measure-preserving requirement have usually done so at the cost of generalizing the averaging process, the existence of suitable weights being inferred from the theorem of Radon-Nikodym.

Denjoy has noticed that when a dynamical system has a positive invariant integral (inducing the measure considered), then if m is positive so is the function

$$\mu(m) = \inf_{E,t} \{ |f(E,t)| : |E| = m, \text{ all } t \}.$$

Assuming this condition alone, without the necessity of an invariant integral, Trjitzinsky has proved Birkhoff's theorem in the original form, with arithmetic means, for the case where the invariant set G has finite measure.

We show that the recurrence theorems of Poincare and of E. Hopf remain valid under this weaker hypothesis and extend Trjitzinsky's theorem to the case where G has infinite measure, using a technique suggested by Stepanov's earlier extension of the Birkhoff result. It is shown that for any pair of measurable subsets of a compact subset of G there exists a relative mean time of sojourn in the two sets.

31 pages. \$1.50. Mic 56-2666

HOMOLOGY REGULAR CONVERGENCE AND LOCAL CONNECTEDNESS

(Publication No. 17,615)

Roger Durgin Johnson, Jr., Ph.D.
University of Virginia, 1956

Suppose $\{A_i\}$ is a sequence of closed sets which converge to the set A in a compact Hausdorff space. The convergence of $\{A_i\}$ to A is said to be regular relative to n -dimensional cycles (n a non-negative integer) if for each $x \in A$ and each neighborhood U of x , then if i is sufficiently large, there is a neighborhood V of x so that any n -dimensional cycle in the intersection of V with A_i bounds in the intersection of U with A_i . It is seen that this type of convergence, introduced by G. T. Whyburn in 1935 ("On Sequences and Limiting Sets," *Fund. Math.*, vol. 25), in a sense "spreads" n -dimensional local connectivity of A over the members of the sequence $\{A_i\}$. Originally n -dimensional regular convergence was studied using Vietoris cycles with the integers mod 2 as coefficients. Later results have been obtained using a field, ring with unit, or a compact abelian group as the coefficient group, and in some instances Čech cycles were employed.

In this dissertation it is assumed that all sets lie in a compact Hausdorff space. We use the Čech homology theory. A fundamental theorem due to E. E. Floyd ("Closed

Coverings in Čech Homology Theory," unpublished manuscript) enables us to employ either a field or a compact abelian group as the coefficient group. Our principal results are indicated below.

Theorems in the aforementioned paper by Whyburn concerning the nature of the limit of sequences of arcs, simple closed curves, topological 2-spheres, and 2-cells under regular convergence relative to 0, 1, and 2-dimensional cycles suggested that the limit of a sequence of sets of dimension $\leq n$ might have dimension $\leq n$ under n -regular convergence (= regular convergence relative to j -dimensional cycles for all $j = 0, 1, 2, \dots, n$). Use of an homology characterization of dimension and Floyd's theorem mentioned above have enabled the author to show that this conjecture is true when the coefficient group is taken to be the reals mod 1.

We extend known results by showing that the limit under n -regular convergence of a sequence of closed sets is locally connected in all dimensions $\leq n$ when the coefficients are in a compact abelian group (theorem (4.1)). Because of homology considerations we have found it convenient to formulate definitions in terms of closed coverings and closed neighborhoods. If U is a closed neighborhood of a point x in the limit set of the sequence above, let V be the closed neighborhood of x given by the definition of n -regular convergence. (4.1) indicates that any closed neighborhood of x contained in the interior of V will serve to show the local connectedness of the limit set at x . We are able to use (4.1) to obtain a simple proof that under n -regular convergence the homology groups (of dimensions $\leq n$) of the members of the sequence are eventually the same as those of the limit set.

A question raised by R. L. Wilder in the appendix of his colloquium publication ("Topology of Manifolds," *Amer. Math. Soc. Colloquium Publication*, vol. 32, 1949) is answered. It is shown that in a compact Hausdorff space the closure of an open set which is uniformly locally connected in all dimensions $\leq n$ will be locally connected in dimensions $\leq n$. In his book Wilder indicated the proof for a metric space when the coefficient group used is a finite field. Our result is obtained when the coefficients are in either an arbitrary field or an elementary compact group (see Steenrod, "Universal Homology Groups," *Amer. Journal Math.*, vol. 58).

46 pages. \$1.50. Mic 56-2667

THEORY OF CONNECTIONS

(Publication No. 17,133)

Shoshichi Kobayashi, Ph.D.
University of Washington, 1956

1. Given a connection Γ in a principal fibre bundle P over M with group G , the author defines the tangential connection $T(\Gamma)$ in the principal fibre bundle $T(P)$ over $T(M)$ with group $T(G)$.
2. The geometrical definition of the curvature form.
3. If H is the holonomy group of the connection Γ , then $T(H)$ is the holonomy group of the connection $T(\Gamma)$.
4. A new definition of the completeness for a Cartan connection.
5. Cartan connections in weakly reductive bundles and a new definition of geodesics.

6. The group of transformations leaving invariant a Cartan connection is a Lie group. By imbedding of the group into the reduced principal fibre bundle, the author describes how the parameters are introduced in the group.
7. If a Cartan connection is complete, an infinitesimal transformation leaving the connection invariant generates a one parameter group of global transformations leaving the connection invariant. For example, a Killing vector field in a complete Riemannian space generates a one parameter global group of isometries.

120 pages. \$1.50. Mic 56-2668

ASYMPTOTIC PROPERTIES OF PARTITIONS

(Publication No. 18,159)

Eugene Edmund Kohlbecker, Ph.D.
University of Illinois, 1956

Let $\lambda_1 < \lambda_2 < \dots$ be a sequence of positive numbers tending to infinity, and let $O = \nu_1 < \nu_2 < \dots$ be the additive semi-group generated by this sequence. Let $p(\nu_i)$ denote the number of ways of expressing ν_i in the form $m_1\lambda_1 + m_2\lambda_2 + \dots$, where the m_j are non-negative integers. The generating function $f(s)$ of $p(\nu_m)$ is given by

$$f(s) = \prod_{k=1}^{\infty} (1 - e^{-s\lambda_k})^{-1} = \sum_{m=0}^{\infty} p(\nu_m) e^{-s\nu_m}.$$

We are concerned only with sequences $\lambda_1 < \lambda_2 < \dots$ which are such that both the product and sum converge for all $s > 0$. Now, letting

$$n(u) = \sum_{\lambda_k \leq u} 1 \quad \text{and} \quad P(u) = \sum_{\nu_k \leq u} p(\nu_k),$$

we see that

$$(1) \quad f(s) = \exp s \int_0^{\infty} \frac{e^{-us}}{1 - e^{-us}} n(u) du = s \int_0^{\infty} P(u) e^{-us} du.$$

Let $L(u)$ denote a slowly oscillating function in the sense of Karamata (*Sur un mode de croissance régulière des fonctions*, *Mathematica*. (Cluj) vol. 4, (1930), pp. 38-53). If α is a given positive number, we define s_u to be a positive number such that, for sufficiently large

$$u, \quad u = \alpha \Gamma(\alpha + 1) \zeta(\alpha + 1) \left(\frac{1}{s_u}\right)^{\alpha + 1} L\left(\frac{1}{s_u}\right).$$

In the thesis it is shown that s_u exists and is determined up to a factor tending to 1 as $u \rightarrow \infty$. Also

$$s_u = u^{-\frac{1}{\alpha + 1}} \left\{ \alpha \Gamma(\alpha + 1) \zeta(\alpha + 1) L\left(\frac{1}{s_u}\right) \right\}^{\frac{1}{\alpha + 1}} \\ \sim u^{\frac{\alpha}{\alpha + 1}} L^*(u)$$

as $u \rightarrow \infty$ where $L^*(u)$ is a slowly oscillating function whose precise relation to $L(u)$ is discussed in the dissertation.

Included as a special case of the thesis is the result that, with the notation of the first paragraph above, $n(u)$

$\sim u^{\alpha} L(u)$ as $u \rightarrow \infty$ if and only if

$$\log P(u) \sim \left(1 + \frac{1}{\alpha}\right) u^{\frac{\alpha}{\alpha + 1}} L^*(u) \quad \text{as } u \rightarrow \infty.$$

Special cases of this result have been given by Knopp (*Asymptotische formeln der additiven Zahlen-theorie*, *Schriften der Königsberger Gelehrten Gesellschaft, Naturwissenschaftliche Klasse*, 2 Jahr, Heft 3, (1925), S. 45-74), Erdős (*On an elementary proof of some asymptotic formulas in the theory of partitions*, *Ann. of Math.* ser. 2 vol. 43, (1942), pp. 437-450), and Brigham (*A general asymptotic formula for partition functions*, *Proc. Amer. Math. Soc.* ser. 1 (1950), pp. 182-191).

More generally, starting with equation (1), where $n(u)$ and $P(u)$ are functions on the non-negative real numbers such that

$$\int_0^R \frac{n(u)}{u} du, \quad \int_0^R \frac{n(u) \log u}{u} du \quad \text{and} \quad \int_0^R P(u) du$$

exist in the Lebesgue sense for every positive R , and α, s_u , and $L^*(u)$ are as before, we obtain the following:

- i) If $n(u) \sim u^{\alpha} L(u)$ as $u \rightarrow \infty$ and $P(u)$ is non-decreasing then

$$\log P(u) \sim \left(1 + \frac{1}{\alpha}\right) u^{\frac{\alpha}{\alpha + 1}} L^*(u).$$

- ii) If $\log P(u) \sim \left(1 + \frac{1}{\alpha}\right) u^{\frac{\alpha}{\alpha + 1}} L^*(u)$ as $u \rightarrow \infty$

and $n(u)$ is non-decreasing, then $n(u) \sim u^{\alpha} L(u)$ as $u \rightarrow \infty$.

To prove i) we go from the assumption on $n(u)$ to a resulting property of the generating function $f(s)$ by an Abelian argument, and then from this property of $f(s)$ to the assertion about $P(u)$ by a Tauberian argument. The latter argument follows the method developed by Hardy and Ramanujan (*Asymptotic formulas concerning the distribution of integers of various types*, *Proc. London Math. Soc.* ser 2 vol. 16, (1917), pp. 112-132).

To prove ii) we go from the assumption on $P(u)$ to a resulting property of $f(s)$ by an Abelian argument and then from this property of $f(s)$ to the assertion about $n(u)$ by a Tauberian argument. The latter step is accomplished in two stages, in order to make use of a known Tauberian Theorem (Theorem 108, Hardy, *Divergent Series*, Oxford at the Clarendon Press, 1949).

40 pages. \$1.50. Mic 56-2669

ON FOUR PARAMETER FAMILIES OF QUADRIC SURFACES

(Publication No. 18,160)

Walter Eddie Koss, Ph.D.
University of Illinois, 1956

In this paper a partial classification of four parameter families of quadric surfaces is made by a geometric ap-

proach which is suggested by a special interpretation of results obtained on certain three-spaces in a paper by H. R. Brahana (American Journal of Math., Vol. 73 (1951), pp. 539-555). Families of quadrics with specific common properties are considered since the general approach is rather unmanageable. The totality, E, of all quadrics

$$\sum_{i,j=1}^4 a_{ij}x_i x_j = 0 \quad (a_{ij} = a_{ji})$$

form a linear system determining a linear projective space, S_9 , of dimension nine. Subsets of E with certain common properties lead to subspaces of S_9 . The quadrics having two intersecting rulings in common, or a ruling and two points in common, or five linearly independent points in common form single four parameter families. The quadrics which have a ruling and a point in common determine a subspace S_5 of S_9 of dimension five. The five parameter family determined by this S_5 is given by

$$\eta_1 x_1 x_3 + \eta_2 x_1 x_4 + \eta_3 x_2 x_3 + \eta_4 x_2 x_4 + \eta_5 x_3 x_4 + \eta_6 x_4^2 = 0.$$

The totality of points in a space which make the matrix of the family singular is defined as a singular locus and a point that makes a matrix have rank-r, $r \leq 4$, is defined as a rank-r point. The singular locus for the family determined by S is the hyperquadric cone $\eta_1 \eta_4 - \eta_2 \eta_3 = 0$ with a line of vertices $\eta_1 = \eta_2 = \eta_3 = \eta_4 = 0$. The points of the singular locus that have special properties are determined. The four-parameter families of quadrics with a ruling and a point in common are classified by finding all possible essentially different S_4 's in S_5 . These S_4 's are differentiated by their intersections with the singular locus in S_5 . The point on the line of vertices determined by $x_4^2 = 0$ is the only rank-1 point on the line of vertices $A_5 A_6$. Each S_4 in S_5 intersects the line of vertices in at least a point and intersects the three-space R given by $\eta_5 = \eta_6 = 0$ in a plane. The four-spaces which contain the line of vertices are different from those which contain only a point of the line and these in turn differ according to whether they contain the rank-1 point or not. Besides these differences there are also the different relations of the plane Π of intersection of an S_4 and R to the quadric $\eta_1 \eta_4 - \eta_2 \eta_3 = \eta_5 = \eta_6 = 0$ in R. Two four-spaces and the four-parameter families they determine are considered essentially the same if a non-singular transformation exists mapping the S_4 's onto each other and mapping the singular locus onto itself.

The four-spaces each containing the line of vertices and each containing a plane which intersects the quadric in R in a non-degenerate conic are essentially the same or different depending on the cross-ratio of four points on the line of vertices which are determined by the intersections of the conics and rulings on the quadric in R.

The quadric families which have only a ruling in common determine a subspace S_6 of S_9 . The singular locus for this family is a hyper-quadric cone $\eta_1 \eta_4 - \eta_2 \eta_3 = 0$ with a plane of vertices. The plane of vertices contains a conic $\eta_5^2 - 4\eta_6 \eta_7 = 0$ each point of which is a rank-1 point. The four-parameter families having only a ruling in common are determined by finding different S_4 's in S_6 . Each S_4 in S_6 intersects the plane of vertices in at least a point and intersects the three-space R, given by $\eta_5 = \eta_6 = \eta_7 = 0$ in at least a line. These S_4 's are likewise differentiated by their intersections with the singular locus.

78 pages. \$1.50. Mic 56-2670

THE DETERMINATION OF SOME DISTRIBUTIONS FOR WHICH THE MIDRANGE IS AN EFFICIENT ESTIMATOR OF THE MEAN

(Publication No. 17,553)

Ernest James Lytle, Jr., Ph.D.
The University of Florida, 1956

The midrange of a sample is a more efficient estimator of the population mean than the sample mean if the ratio of $\sigma_{\bar{x}}^2$, the variance of the distribution of the means, to σ_M^2 , the variance of the distribution of midranges is greater than unity and provided the midrange is an unbiased and consistent estimator of the mean. These last conditions will be true when the population is symmetric. Since the midranges of samples taken from a rectangular distribution are more efficient than the means of these samples and since the means of samples from the normal distribution are more efficient than the midranges and varying a parameter of the Pearsonian Type II distribution function, the function changes from the rectangular to the normal. It seems reasonable to suppose that there must be an interval over which the parameter may vary, so that the midrange is more efficient. This paper is concerned with finding the bounds of this interval.

58 pages. \$1.50. Mic 56-2671

I. SOME DUALITY THEOREMS II. ON THE CHARACTERS OF CERTAIN COMPACT ABELIAN GROUPS

(Publication No. 17,266)

Justin Jesse Price, Ph.D.
University of Pennsylvania, 1956

Supervisor: Dr. Nathan J. Fine

A recent theorem of N. J. Fine asserts that a multiplicative semi-group of functions which form an orthonormal system of functions on a measure space is essentially the group of characters of a certain compact abelian group. The purpose of Part I is to obtain analogous results in the case of nonabelian groups.

One defines a Kronecker system on a set S to be a family of matrix-valued functions on S satisfying a type of closure property with respect to Kronecker multiplication. With every Kronecker system on S is associated a dual group which can be topologized in a natural way. Conditions are found in order that S may be imbedded in the dual group in such a way that the given Kronecker system becomes essentially a complete set of irreducible representations of the dual group. The duality methods used lead to a general theorem which includes both the theorem of Fine mentioned above and the duality theorem of Tannaka.

Part II studies the characters of a certain class of compact abelian groups, namely those which are countable direct products of finite cyclic groups. These characters are realized as groups of orthonormal step functions on the unit interval. Each function has finite order. If all orders are equal to two, this is the group of Walsh func-

tions. The analytic properties of the Walsh system have been widely studied. Other groups of this type, where the orders of the functions are bounded, have also been studied. Their properties are quite similar to those of the Walsh group.

The object of Part II is to demonstrate that, if the orders of the functions are allowed to be unbounded, completely different properties are found. The Fourier expansions of several functions are derived. Using these, the following principal results are obtained, all of which differ

markedly from the corresponding results for groups of bounded order. There exist functions of bounded variation and functions in Lip 1 whose Fourier coefficients are not $O\left(\frac{1}{n}\right)$. There exist continuous functions whose Fourier series are not summable (C,1) at a preassigned point. fast enough, there exist functions in Lip 1 whose Fourier series and (C,1) means diverge to infinity at every point of a dense set. 52 pages. \$1.50. Mic 56-2672

MUSIC

A STUDY RELATING TO THE BOY'S CHANGING VOICE: ITS INCIDENCE, TRAINING, AND FUNCTION IN CHORAL MUSIC

(Publication No. 17,026)

John Milton Gustafson, Ph.D.
The Florida State University, 1956

Much disagreement is evidenced as to the desirability of the use of the boy's changing voice in choral groups, both from the standpoint of the good that the group may derive from the use of this voice and the good the voice may receive from this singing experience. Music educators differ widely in their concepts of the range, scope, and function of the changing voice. Statistics show undue mortality rates in junior high school vocal music, especially among boys, and yet other studies prove that boys are naturally as musical, if not more musical, than girls. Because of this apparent inconsistency, it was proposed that an evaluation of various concepts used with groups which include changing voices and analyses of current materials purportedly written and arranged for these groups, might clarify the thinking of music educators as to the range, scope, and function of the changing voice in the school music program.

The study first presents a brief historical account of choral singing, tracing the use and training of the boy voice in Western culture, and including a poll of existing practices among various selected boy choirs in Europe and America. In tracing the use or disuse, the training, and function of the boy's changing voice in choral groups, six significant concepts are apparent. For the purposes of this study the concepts are defined: (1) English choir-master's concept which advocates a period of rest for boys during the period of change, (2) SATB, or adult concept which uses easy arrangements of adult music with more limited vocal ranges for adolescent voices, (3) alto-tenor concept which attempts an adjustment in the tenor range to suit the changing voice, (4) SAB concept which combines the tenor and bass parts to form a single baritone line, (5) general music concept which avoids singing in its use of

other musical activities, and (6) cambiata concept which employs very definite vocal ranges for choral groups which include changing voices.

Literature in the fields of physics, acoustics, speech, physiology, psychology, and education which pertains to the boy or his voice during the changing period is surveyed in order to ascertain the extent to which each of the concepts is compatible with the thinking of related fields.

As representative of choral music written for groups which include children in the age of voice mutation, junior high school general music texts published by the four principal music publishing houses of the United States were used. Criteria were established by which the 3838 songs included in twenty-eight texts might be analyzed objectively to determine types of vocal arrangements used, readability and articulation speeds employed, vocal ranges of the various voice parts, melodic interest in each part, and the musical and textual suitability of songs for junior high school students. The following was noted: (1) There is a trend toward greater reading ease through larger print and fewer parts per staff. (2) Recent publications include more related material and illustrations, resulting in texts compiled by committees rather than single-author song collections. (3) An increase is noted in the number of folk-songs, recreational-type songs, and songs for voices in unison. (4) In regard to vocal ranges, unison songs are written in soprano rather than composite ranges, there is great variance in ranges for the changing voice, and a trend from bass to baritone range for the changed voice.

Analyses of song materials in the light of research studies in related fields show improvement in some areas, notably the tendency toward greater reading ease, inclusion of related matter, and greater variety in song texts. Startling variance in concepts as to the scope of the changing voice suggests that range concepts might be improved, since out-of-range songs can lead to indifferent singing. On the basis of these findings criteria are established for the selection of music suitable for adolescent choral groups, recommendations are made for more effective teaching practices, and suggestions are given for further study in the realm of the boy's changing voice.

133 pages. \$1.80. Mic 56-2673

PHARMACOLOGY

STUDIES OF THE ANTIMICROBIAL PROPERTIES OF ION EXCHANGE RESINS

(Publication No. 18,323)

Edward Joseph Eugene, Ph.D.
The University of Connecticut, 1956

A report of the use of an ion exchange formulation (trade name, Vacid) in the control of chronic lower genital tract infections led us to investigate the antitrichomonal properties of ion exchange substances.

The effects of two ion exchange preparations on *Trichomonas vaginalis* vaginitis in monkeys were studied to determine the necessity of the sodium chloride in the formulation. The results of screening Amberlite XE 112 buffered to pH 3.5, indicated that all five monkeys treated were "cured". Addition studies employing Amberlite XE 112 buffered to pH 3.5 and containing sodium chloride demonstrated that two of the five monkeys were "cured".

The *in vitro* studies of the antitrichomonal properties of ion exchange substances have demonstrated that two linear polymers, two sulfonic acid type resins, and seven carboxylic type resins, have a direct inhibitory action on *Trichomonas vaginalis*. It was shown that all of the compounds tested against *Trichomonas vaginalis* had for their mode of action the lowering of the pH of the metabolism solution.

During the course of our investigation, it was shown that when Amberlite XE 112 is reacted with components of STS medium, only the treated human serum would not support growth. Therefore, it was concluded that Amberlite XE 112 was picking up nutrients from the serum which are essential for the growth of *Trichomonas vaginalis*. Further studies indicated that when Amberlite XE 112 was reacted with serum, the treated serum would not support sustained

growth of trichomonads, nor would the resin eluates obtained by eluting the serum-resin complex with either hydrochloric acid or Sorensen's buffer support growth. However, when these eluates solutions were combined with the treated serum normal growth was observed. Additional studies proved that hydrochloric acid and Sorensen's buffer were equally effective agents for eluting the nutrients from the serum-resin complex.

To eliminate the equilibrium type study of treating serum, ion exchange column chromatography was employed. It was shown by this method that when Amberlite XE 89 buffered to pH 6.0 was used in the column, some of the constituents of serum were removed. The resulting effluent serum would not support normal growth of *Trichomonas vaginalis*. Likewise, when the column was divided into an upper and lower portion and each resinous fraction eluted with hydrochloric acid, neither fraction would support growth. However, when a portion of the liquids from the upper fraction, lower fraction and effluent liquid were combined, normal growth was observed.

To investigate possible growth stimulating substances which occur normally in serum but not in simplified trypticase basal medium, certain amino acids were studied. These amino acids were added to the simplified trypticase basal medium and effluent serum with the view of restoring growth of trichomonad population to normal. Results of this work demonstrated that tyrosine had no appreciable effect on the growth of trichomonads; however, glycine, lysine, and serine had a very slight stimulating effect. It was noted, however, that glutamine had a marked stimulating effect on the growth of *Trichomonas vaginalis*. This is important from the point of view that new potential antitrichomonal drugs may be developed by designing and screening antimetabolites of glutamine.

75 pages. \$1.50. Mic 56-2674

PHILOSOPHY

A DEFENSE OF THE POSSIBILITY OF OBJECTIVE AESTHETICS

(Publication No. 17,600)

Robert Sedgwick Bryan, Ph.D.
University of Virginia, 1956

This thesis attempts to show not only that objective aesthetic theory, founded on appropriate metaphysical principles, can be justified, but also that it is more adequate and satisfactory than the naturalistic theories which dominate modern aesthetics. The type of theories opposed here is that which reduces aesthetic judgments to descriptions or expressions of some psychological state in an observer or group of observers. According to theories of this type,

scientific investigations will tell us why we respond to some objects and not to others, and art criticism takes the form of "persuasive definitions".

The grounds of these theories are obtained by asking a set of questions of the so-called aesthetic situation which are appropriate only to descriptive judgments. Since judgments, which purport to refer to some characteristic of the objects judged, cannot be verified, it is assumed that aesthetic judgments are only descriptive or expressive of some psychological state. There is no unanimity among these theorists concerning the nature of this psychological state, and there seem to be inherent difficulties in these views. This thesis devotes chapters to these inherent difficulties in both subjectivism and emotivism.

The demand that aesthetic judgments, if they are to be

meaningful, must be descriptive or expressive, appears to cut off an objective approach. However, an analysis of aesthetic language indicates the inappropriateness of the type of questions asked in these naturalistic theories. It is objects which we say are beautiful, and when we do, it is not appropriate to ask us to verify judgments, to produce evidence, to show them to be true. If one should say that a landscape was beautiful, it would be improper to ask how one knows, but rather, why one thinks so. We do not ask for verification, but for justification; we do not ask for causes of a response but for reasons for a judgment; we do not ask if the judgment is true or false, but if it is right or wrong. And questions of this sort, instead of cutting off the possibility of an objective theory, rather suggests one.

Now, attempts to establish fixed criteria, especially in fine art, have, in the past, produced sterile generalizations, and clearly no one has ever produced certain, inviolable, and satisfactory rules either for creating fine art or for judging it. But then it is often maintained that if we attempt to seek principles of beauty, metaphysical in nature, we are likely to result in talking nonsense. The best that can be said about metaphysics, according to some philosophers, is that metaphysical questions have no answers, and metaphysical statements are neither verifiable nor refutable by common sense. But again it is argued in this essay that the wrong questions have been asked, and an analysis of the kind of language used in metaphysics - an examination of the logical structure of metaphysical language - will indicate the proper kinds of questions. Again, instead of asking questions which are proper only to ordinary descriptive judgments, it is more appropriate to ask for the reasons for a metaphysical perspective, and these reasons serve to justify that perspective. Indeed, metaphysics must obey certain linguistic rules, but these are not the rules of ordinary language; rather they are the rules of metaphysical language.

Obvious facts, which actually occur, are the final arbiter of any theory. And it is held in this essay that subjectivist and emotivist aesthetics are inadequate to these facts. An objectivist theory, on the other hand, which ultimately appeals to "reasonable" metaphysical principles, is, in itself, a more satisfactory type of theory.

148 pages. \$1.95. Mic 56-2675

ETHICAL AND LEGAL THEORY IN THE UNITED STATES: A COMPARATIVE STUDY

(Publication No. 17,223)

John D. Dutton, Ph.D.
University of Pennsylvania, 1956

Supervisor: Professor Elizabeth F. Flower

The dissertation seeks to elicit suggestions which may be helpful for advance in Anglo-American ethical theory from a study of some recent developments in Anglo-American legal theory. The classifications of ethical and legal theories adopted, while not exhaustive, are readily recognizable in current literature in the two fields. Subsequent to a presentation of the views propounded by some representative authorities in each field, the intuitionist, naturalist and emotivist theories of ethics are compared

to the analytical and sociological theories of law.

Results of the comparison show that ethical theory and legal theory have encountered similar, if not identical, difficulties which have served to perpetuate disagreement rather than promote agreement. Arguments over the matter of "verification" and "reduction of 'ought' to 'is'," as well as such distinctions as "prescriptive-descriptive," "subjective-objective," and "rational-emotive" have characterized literature in both fields. It is shown that there are a considerable number of points upon which the theories of Max Radin, Edmond Cahn and Albert Kocourek in law coincide with the ethical theory propounded by C. L. Stevenson. The views of these three legal theorists are held to constitute an embryonic Anglo-American synthesis suggestive of a level of agreement for approach in the field of law to the difficulties cited above. Discussion of intuition, formulation of postulates and first principles, and insistence upon exclusivist claims are not found to have a prominent role in literature published by these legal theorists. They share the view that legal theorist and practicing jurist have a common interest in normative judgement and cognitive assertion. The heuristic division of labour between practicing jurist and legal theorist is not considered to be a "real" barrier to cooperation.

Current legal theory stresses study of reasons given for decisions in specific cases at law, employment of reasonable consistency and precision in technical legal terminology and abandonment of the supposition that the emotive character of the evaluative factor in law makes that factor capricious.

The results of the comparative study of ethical and legal theories are construed to provide certain suggestions for ethical theory. Ethical theorists may take the hint from law and forego discussion of intuitions. Not that intuitions are not operative, rather because this is trivially so. If legal theorists, possessing as much case study data as they do, are chary about forming general postulates, ethical theorists and moral philosophers alike might do well to follow their example. Inasmuch as many judges have chosen to become legal theorists, moral philosophers may choose to become ethical theorists. It is contended that confusion would be lessened if the two tasks were differentiated without fear of the consequence that theoretical "detachment" or practical "sensitivity" need be sacrificed. The technical language of ethical theorists need not be antithetical to the practical language of moral philosophers. The modest claim is made that Stevenson's ethical theory seems to have sufficient in common with contemporary developments in legal theory to warrant further elaboration of his views in the direction of proposals made by R. M. Hare and S. E. Toulmin. 166 pages. \$2.20. Mic 56-2676

H. H. PRICE'S ANALYSIS OF THE NATURE OF CONCEPTS

(Publication No. 17,007)

Lawrence Resnick, Ph.D.
Cornell University, 1956

As a critical examination of H. H. Price's theory of thinking (especially as expressed in *Thinking and Experience*), this dissertation begins with a detailed elucidation

of Price's doctrines that recognition is the fundamental intellectual process, and that a concept is essentially a recognitional capacity. In order to put Price's thesis in its proper historical perspective, a comparison is made between it and the related theses of the traditional Empiricists, Locke, Berkeley, and Hume. Price's doctrine of the nature of concepts appears to have many advantages over the traditional Empiricist notions of the nature of concepts. These advantages are traceable to Price's analysis of the possession of a concept as a function of dispositional memories, rather than as a function of introspectable phenomena.

Price's argument that recognition is the fundamental intellectual process is found to depend, in part, upon using the word "recognition" in a way which would normally be counted as incorrect. To see whether this can be taken as a mistake in Price's doctrine, the relevance to philosophy of "linguistic" or "grammatical" considerations is brought into question. The notions of picture, criterion, symptom, and surroundings, used by Wittgenstein in the Philosophical Investigations are explained, examined, and then applied to show the relevance of linguistic considerations. It is found that no discovery could possibly show Price's use of "recognition" to be correct, and that Price's objection to the linguistic argument is founded on a mistaken assimilation of "X is a matter of convention" and "X is a matter of opinion". But Price's misuse of "recognition" must be distinguished from the sort of misuse which is the result of the failure to master English. The notion of a philosophical misuse is explained. When one sees how such a

misuse arises, one sees that the conclusions which depend on the misuse are revealed as confusions by the application of certain "linguistic" or "grammatical" procedures.

Price's claim that recognition is necessary to every case of the "exercise" of concepts depends on his view that "He recognized X" and "He failed to recognize X" are contradictory. But in some surroundings, so it is argued, one notices familiar objects and neither recognizes nor fails to recognize them. It is only in circumstances in which there is a "question of recognition" that, e.g., the correct identification of an object counts as recognition of that object. When we are reminded of the criteria of "recognition", we can see that recognition is not necessary to every exercise of the manifestations of concepts.

Price's notion of the role of recognition in the acquisition of concepts depends on the supposition that recognition can occur in the "primitive consciousness". But analysis shows this supposition to be mistaken, since one cannot say of any being, which does not at least exhibit "directed" behavior, that it recognizes. We can agree with Price that recognition is independent of its manifestations in the sense that one can recognize without exhibiting any signs of recognition; nevertheless recognition is not independent of its manifestations in the sense that a being which cannot exhibit such manifestations can be said to recognize.

Finally the notion of a concept, as conceived by the Empiricists, is examined critically. The thesis is advanced that no entity could perform the role in thinking assigned to the concept by Locke, Berkeley, Hume, and Price.

184 pages. \$2.40. Mic 56-2677

PHYSICS

PHYSICS, GENERAL

MEASUREMENT OF THE TEMPERATURE
DEPENDENCE OF THE MOBILITIES OF
POSITIVE IONS IN GASES

(Publication No. 17,173)

Earl Claude Beaty, Ph.D.
Washington University, 1956

Chairman: Robert N. Varney

The mobilities of positive ions of argon and krypton in the parent gases have been measured at room temperature and at one lower temperature, 77.4° K in argon and 90° K in krypton. In each case the atomic ions were found to have a higher mobility at the lower temperature. For A⁺ in A the mobility, extrapolated to zero field, at 77.4° K was 1.36 times the value at 300° K. Extrapolation could not be carried out accurately in krypton but evidence is found that the ratio of the mobility at 90° K to the value at 300° K is somewhat larger than 1.2. The change in temperature was found to have no effect on the mobilities of the molecular ions. Agreement of the room temperature results with those of other investigators is good except for a large disagreement with Biondi and Chanin on the molecular ions. The disagreement is particularly large

for A₂⁺ at low E/p₀ and suggests a difference in the ions measured in the two experiments.

57 pages. \$1.50. Mic 56-2678

A STUDY OF THE FLARING AND ABLATION
ASSOCIATED WITH ULTRA-SPEED PELLETS

(Publication No. 17,566)

Emerson Taylor Cannon, Ph.D.
University of Utah, 1956

Co-Chairmen: Joseph W. Berg, Jr., and William S. Partridge

Techniques for measuring the ablation and the minimum velocity at which flaring of ultra-speed pellets will occur are described. A velocity measuring system employing a "break" circuit is described which was successful in measuring velocities up to 1.5 km/sec. The ablation of ultra-speed pellets is determined by measuring the diameter of the hole punched by the pellets in a paper grid that was placed in their paths.

No evidence was found that the minimum velocity at

which flaring occurs is dependent on the presentation area of the pellet for the range of areas which were investigated. The minimum velocity at which flaring occurs are reported for Al, Mg, Ti and Cu pellets 0.25 inches long and 0.219 inches in diameter. These velocities are 1.10, 1.08, 1.17 and 1.34 km/sec, respectively, when the pellets are shot from a .22 caliber gun 60 inches long.

The ablation per unit area and the ablation per unit mass seem to have a linear relationship with velocity in the velocity range which was attained. The results of this relationship are discussed in light of the meteor theory of ablation. The ablation as a function of the distance from the end of the gun barrel is also investigated. It is found that aluminum pellets have the rate of ablation of 10^{-1} to 10^{-2} grams per gram per meter of path length. A calculation from the data reported here of the energy lost by the pellet in flight indicates that the ablation process might be one of melting the metal and sweeping it off the pellet.

An extension of the results of this investigation to the meteor ablation leads to a trail length of about 10 kilometers for an aluminum meteor. This value is 80 to 90 percent smaller than the observed trail lengths for meteors. It is suggested that work with the materials of which meteors are composed might lead to the observed meteor trail length. 57 pages. \$1.50. Mic 56-2679

A RADIO-ECHO STUDY OF ATMOSPHERIC TURBULENCE IN THE LOWER IONOSPHERE

(Publication No. 18,295)

Robert Solomon Cohen, Ph.D.
Cornell University, 1956

Several experimental techniques were employed for the purpose of determining the variation with radio frequency of direct backscatter from ionospheric irregularities, which arise from atmospheric turbulence in the lower E-region of the ionosphere.

The first approach was an attempt to obtain radio echoes from the prevailing turbulence by employing a powerful radar consisting of a 200-kw. pulse transmitter in conjunction with a paraboloidal antenna 100 feet in diameter beaming vertically upward at a frequency of 27.85 Mc/sec. No reflections were obtained during repeated trials in 1954, nor upon resorting to integration procedures in early 1955.

The negative results are explicable on the basis of certain modifications in theoretical predictions which have meanwhile become available. The original design of the experiment was based upon a frequency dependence stated by Booker and Gordon in 1950 to be a power law f^{-4} . A more elaborate theory developed by Villars and Weisskopf in 1953 suggested an exponent somewhat higher than 4 in this frequency region, a conclusion that has been borne out by forward-scatter measurements of the National Bureau of Standards.

A renewed effort to obtain backscatter information was made in the summer of 1955, when, on the basis of his theoretical analysis of ionospheric turbulence and of long-duration meteor echoes, H. G. Booker suggested a novel, indirect approach for examining the ionospheric region of

interest. This method relies upon the taking over by existing atmospheric turbulence of the ionization produced in the lower E-region by meteors. The theoretical development predicts that the trails will break into small eddies in about 0.4 seconds, and gives the time behavior of the decaying reflection obtained from the meteoric ionization as a t^{-3} law. Furthermore, the meteor trails are expected, after a few seconds, to scatter in the same way as the background irregularities, i.e., by turbulence. Thus, the meteors literally illuminate the phenomenon to be studied, and the new approach was to observe continuous-wave transmissions reaching the receiver by bouncing off meteor-trail ionization.

With a view toward studying ionospheric turbulence and verification of the Booker meteor theory, experiments were undertaken late in 1955 using transmitters and receivers separated by 31 km of hilly terrain, so as to suppress the direct signal. Three frequencies were available for simultaneous observations (approximately 17, 30, and 50 Mc/sec), and identical dipole antenna systems were in use at each of them. High-speed recordings on dual-channel paper tape were taken of pairs among the three frequencies during meteor showers and also when only sporadic meteors were present.

Results of an analysis of the meteor events of interest show that, on all frequencies, the decrease in amplitude of long-duration echoes after they begin to decay is in accordance with the Booker theory, field strength being inversely proportional to the third power of the time subsequent to trail formation. The wavelength dependence of the irregularly fading echoes is also investigated, and found to bear out the predictions of the Villars and Weisskopf theory. Some information is derived concerning the spectrum of atmospheric turbulence in the visibility range. 58 pages. \$1.50. Mic 56-2681

SCATTERING OF ELECTRONS BY LATTICE VIBRATIONS IN CRYSTALS

(Publication No. 18,147)

Walter Ashley Harrison, Ph.D.
University of Illinois, 1956

The purpose of this work is to attempt to supply a general analysis of the scattering of electrons by lattice vibrations. This analysis allows for comparison of the relative importance of scattering of electrons by acoustical and by optical modes of vibration.

The presentation includes a study of the vibrational modes in crystals possessing two atoms per unit cell. The detailed form of the modes, as determined by the crystal symmetry, is developed in a manner which is particularly suitable for use in a scattering calculation. It is found that a coupling between acoustical and optical modes occurs in crystals in which each atom is not a center of symmetry. Because of this coupling, there is an electrical polarization associated with acoustical modes in certain polar crystals. This polarization may be understood in terms of the piezoelectric effect. The coupling parameters entering the expressions for the normal modes are evaluated explicitly for diamond, germanium, and silicon by constructing a force model for atomic inter-

actions. The force constants are evaluated in terms of the elastic constants for each crystal. Particular notice is taken of the requirement that the force model be invariant under bulk rotations of the crystal.

Consideration of electron scattering in non-polar crystals is restricted to the monatomic case in which there are two atoms per unit cell. The scattering is approached using a generalized deformable-ion model since it would be difficult to extend the deformation-potential method in a way that would allow an estimate of the relative importance of acoustical- and optical-mode scattering. The scattering matrix elements are expanded in powers of the electronic wave number and classified in terms of the order of magnitude of the first nonvanishing term for acoustical and for optical modes. The particular case of scattering of holes and of electrons in germanium and silicon is considered in detail. Estimates are given of the relative magnitudes of the relaxation time for scattering by optical and by acoustical modes for each case. Finally, the temperature dependence of the mobility is discussed in the light of these results.

The contribution to the electron scattering arising from electrical polarization associated with acoustical modes is calculated for crystals of the zinc-blende structure. The form of the polarization is found from the study of the vibrational modes. The scattering is calculated explicitly, making an effective-mass approximation. The mobility is estimated in the cases of zinc blende and indium antimonide. 96 pages. \$1.50. Mic 56-2682

LOW TEMPERATURE RELEASE OF STORED ENERGY IN COLD WORKED COPPER

(Publication No. 18,149)

James Wedd Henderson, Ph.D.
University of Illinois, 1956

Pure polycrystalline copper and alpha-brass specimens were deformed in compression at temperatures near -185°C . The release of stored energy was observed during subsequent warmups to room temperature and above. The annealing spectrum of pure copper shows prominent peaks at -25°C and -90°C , and smaller resolvable peaks at lower temperatures. The total energy release was about 0.17 cal/gm for a specimen strained to 0.65. In contrast to pure copper, the spectrum for brass shows only one clearly resolvable peak at -10°C and extends to higher temperatures. The energy release was almost three times that of pure copper for comparable strains.

The sensitivity of the experimental method is about 10^{-4} cal/gm per degree centigrade, and the results are believed to be accurate to about ten percent. The apparatus was calibrated by measuring the known heat-of-fusion of mercury. 40 pages. \$1.50. Mic 56-2683

INDIRECT MAGNETIC EXCHANGE INTERACTIONS IN CRYSTALLINE OXIDES

(Publication No. 17,242)

David A. Kottwitz, Ph.D.
University of Pennsylvania, 1956

Supervisor: Dr. Herbert B. Callen

A straightforward and unified formal treatment is carried out in the standard triatomic model for the various indirect magnetic exchange interactions, including superexchange, degenerate superexchange, double exchange and semicovalent exchange. For each interaction explicit determinantal wave functions are used in a configuration interaction calculation typically based on perturbation theory. Orthogonal atomic orbitals are assumed, but matrix elements are considered as disposable parameters. The final result for each interaction is an expression for the over-all "effective exchange integral" in terms of pertinent exchange and transition integrals. Numerical calculations are made to test various approximations made in the work. In the case of superexchange, a certain hitherto neglected exchange integral is shown to have only a small effect; the physical reasons for this are discussed. The choice of perturbing excited states is also discussed; in particular the necessity of diagonalizing the excited states is emphasized. Degenerate superexchange, a natural extension of superexchange discussed in detail for the first time here, is shown to give results qualitatively the same as ordinary superexchange for physically reasonable values of the parameters. A brief calculation of double exchange gives the well-known result. Semicovalent exchange involves too many configurations for a complete treatment. However, a simple extreme case can be handled by merely rewriting the results for superexchange; this case gives a magnetic coupling in accord with the original qualitative picture of semicovalent exchange. In conclusion, the difficulty of identifying the dominant interaction present in a given material is discussed. 88 pages. \$1.50. Mic 56-2684

PART ONE: SHOCK WAVE SPECTROSCOPY. PART TWO: ENGINEERING MAGNETO-HYDRODYNAMICS.

(Publication No. 18,285)

Richard John Rosa, Ph.D.
Cornell University, 1956

In Part One a moving film technique is described for photographing strong shock spectra.¹ The method consists essentially of moving the film at a velocity at or near the velocity of the image of the shock wave. If the velocities are within 5 percent of each other the exposure time is increased by a factor of twenty. The light from different regions of the shock is separated on the film.

Space resolved spectra of Mach No. 10 shocks in argon were obtained. These indicate that the "luminous front" phenomena² is due to impurities; specifically carbon bearing compounds. Experiments with a probe filled with liquid N_2 also indicated impurities are responsible. The spectra show the Swan bands of C_2 and the violet CN bands

reaching a maximum intensity close to the front and tailing off behind. The rate of disappearance of the bands indicates that the cross section for dissociative collisions is about 10^{-16} cm². The apparent high degree of electronic excitation of these radicals very near the shock front leads to the conclusion that the excitation process is an atom-molecule collision having a cross-section which is quite large (of the order of 10^{-16} cm²).

Spectra using this same technique were obtained which permitted an analysis of the vibrational temperature of the CN radical. The results were good enough to indicate that this type of spectroscopy can be made to give sufficient resolution for a number of tasks.

In Part Two the application of magneto-hydrodynamics to engineering, specifically to hypersonic gasdynamics, is studied. The electrical conductivity which is necessary and the corresponding degrees of ionization are discussed in terms of the energy required for their production. It is shown that in air and probably in all molecular gases, this energy may be quite large. It is proposed that the "seeding" of the gas with a small amount (about 0.1 percent) of an easily ionizable element is a practical way to overcome this difficulty. It is shown that in air the temperature required to prevent chemical combination of the seed atoms with the parent gas corresponds to an enthalpy of one-half to two electron volts, depending on the atmospheric pressure and the element used for seeding. Under some conditions it appears that reaction rates may be so slow that no energy is required.

Calculations are made of the rate of thermal ionization, ionization by fields, and photoionization. The various collision processes apt to be important are discussed and the energy lost in heat is estimated. The probable upper limit of the rates of recombination and attachment are estimated for various gas pressures and electron temperatures. It is concluded that it should be possible to obtain a degree of ionization of about 10^{-4} in seeded air with very little heating of the gas as a whole and that a seeded molecular gas will remain ionized for an appreciable length of time.

These studies also make it possible to deduce the seeding elements which should be best for a specific purpose. Experiments are proposed to test the effectiveness of a given seed element and to provide the data which is missing for a number of the important processes involved.

Finally, the equations of magneto-hydrodynamics are solved for a few relatively simple cases to show some of the properties and possible applications of the flow of gases with finite conductivity through electric and magnetic fields.

173 pages. \$2.30. Mic 56-2685

1. R. J. Rosa. Phys. Rev. 99, 633 (A) (1955).
2. H. E. Petschek, Phys. Rev. 84, 614 (A) (1951).

VHF RADAR ECHOES ASSOCIATED WITH ATMOSPHERIC PHENOMENA

(Publication No. 18,308)

Gian-Carlo Rumi, Ph.D.
Cornell University, 1956

VHF radar observations during the summer and fall of 1955 at Ithaca, New York, gave us useful information, not

only about lightning, meteors, and aurora, but also about the existence and the characteristics of "upward discharges" leaving the top of the troposphere and moving toward the ionosphere. The existence of such discharges and their detectability create many new problems requiring further study.

Two radars were used for the present research. One was operated at 106.5 megacycles per second, and the other at 27.85 megacycles per second. A special feature was the photographing from magnetic tape records that were played back to reproduce the original oscilloscope presentation. This technique proved to be useful in permitting more detailed analysis than had previously been made.

Photographs are presented that show examples of two main groups of echoes in their amplitude-versus-time display. The first group are echoes from lightning. The second group are echoes that we have attempted to associate with the so-called upward discharges. Photographs of a simple meteor echo and of a meteor echo embedded in an auroral echo are also included.

The discussion and interpretation of the lightning echoes led us to conclude that we had records of discharges within a thundercloud. We also advanced a method for the indirect deduction of the diameter of the discharge. From the nature of the noise accompanying our echoes, we infer the existence of horizontal trails preceding our flashes of lightning. We also noticed an apparent multiple reflection with the thundercloud discharge as an intermediate reflector.

The second group of echoes were similar to meteor echoes, but their characteristics made it incorrect to attribute them to meteors. The reasons for not classifying these echoes as being of meteoric origin are as follows:

- (1) The speed of production of the ionization was too high.
- (2) The ranges of these echoes were inconsistent with those expected for meteors.
- (3) The duration and shape of our echoes were not in accordance with meteor theory.
- (4) The decay was not exponential, but instead had Fresnel diffraction aspects.
- (5) Our echoes did not occur at the times when sporadic meteors and meteor showers were expected.
- (6) Repetitions of the echoes were recorded, and this would be unlikely in the case of meteors.
- (7) On one occasion we recorded an echo that we interpreted as reflected from a height between 20 and 60 kilometers, a height too low for meteors.

The preceding inconsistencies with meteor echoes were confirmed by a synthetic approach as well as by this analysis. The idea of upward discharges was deduced on the basis of discreteness, speeds, duration, flatness of the tops, decay behavior, ranges, and repetition. Confirmation of our deduction from both the theoretical and experimental points of view was found in the scientific literature.

An essential difference between the ionized column produced by a meteor and the ionized channel caused by an upward discharge is the curvature. The usefulness of this criterion for discriminating between meteor echoes and upward discharge echoes is discussed.

Some evidence to show that meteors may play a role in the generation of upward discharges, probably as the triggering agent, appears in our records. The assumption

is not at all unreasonable if we consider a meteor trail as a lightning rod for an upward discharge.

Information about meteors and aurora was gathered during the course of the experiment. The principal findings are mentioned. 80 pages. \$1.50. Mic 56-2686

PAIRWISE CORRELATIONS IN THE MANY-BODY PROBLEM

(Publication No. 18,310)

Frederick William Schmidlin, Ph.D.
Cornell University, 1956

A set of "pair-equations" are derived by means of the variational principle for calculating the correlations between pairs in a system of interacting particles. It is shown that a first order solution of these equations can be obtained by considering independently the motion of each pair in the Hartree-Fock field of the remaining $N-2$. In other words, a stationary state equation is obtained for each pair of particles in which the potential and exchange energy of the pair due to their interaction with the other particles is expressed only in terms of the Hartree-Fock "spin-orbitals." Therefore, one can make an immediate correction for the pairwise correlations in any system for which the Hartree-Fock solutions are known. Moreover, one can simply treat those pairs which on physical grounds are believed to contain the most correlation, e.g., valence electrons or those with antiparallel spin. The equations can be solved with the use of trial functions as in the treatment of the helium atom by Hylleraas. Analogous equations are also derived for Bosons.

It is shown that the pair equations can be further simplified by neglecting the exchange operators without introducing serious errors. Moreover, one can use the simpler Hartree solutions to form the two-particle potentials. With this modification the mutual interaction of the particles is allowed to manifest itself in the correlations before any is taken into account "accidentally" with the antisymmetrizer.

A wave function for the total system is constructed from the solutions of the pair-equations which, after appropriate symmetrization, is used to obtain formulae for the total energy. It is shown that the antisymmetrization of the wave function gives an automatic correction for the Pauli exclusion principle which is neglected in the pair-equations. The symmetrizer supplies a similar correction in the case of Bosons. Projection operators are presented for facilitating these corrections.

For comparative purposes a perturbation treatment of the many-body problem is also presented in which the difference between the instantaneous and average interaction (computed with the Hartree-Fock solution) is treated as the perturbation. It is shown that the correlated-pair approximation can yield an energy which is at least accurate as third order in the above perturbation method.

The relationship between the correlated pair method and the method of configurations is pointed out. The pair-method effectively includes in one term all possible configurations (usually an infinite number) which can be formed by replacing a given pair of spin-orbitals in the

Hartree-Fock configuration by any pair of orthogonal orbitals.

The method is illustrated by applying it to a system of coupled harmonic oscillators treated as Bosons. This is believed to be a critical test because of the long range force. The exact and Hartree-Fock solutions are also obtained for comparison. It is shown that at least 90% of the correlation energy (the difference between the exact and Hartree-Fock energies) can be accounted for pairwise if the ratio of the interaction to "core" potential is less than or equal to the reciprocal of the number of particles. Even better results are expected for electronic systems. 161 pages. \$2.15. Mic 56-2687

ANTIFERROMAGNETISM IN SINGLE CRYSTALS OF NiO AND CoO — AN INVESTIGATION BY MEANS OF SUSCEPTIBILITY MEASUREMENTS

(Publication No. 18,339)

Jerome Ralph Singer, Ph.D.
The University of Connecticut, 1956

The purpose of this work is the study of the magnetic susceptibility of single crystals of NiO and CoO as a function of pressure and temperature. Information on the spin orientation is obtained from the measurements. The molecular field approximation of Van Vleck is discussed since the interpretation of these measurements is based upon this theory. An account is given of the apparatus, the measurements, the interpretations, and previous work on these compounds.

Some original modifications were made on the susceptibility balance employed. The null balancing of the force on the crystal sample due to an inhomogeneous magnetic field is obtained by suspending a coil in an identically inhomogeneous field and energizing it with a fixed fraction of the magnet current. The operation of the balance is then semi-automatic since any increase in magnet current increases the balance coil current in just the right amount to maintain a null position of the balance.

Heating the NiO crystal to 900°K and slowly cooling it while maintaining about 2000 pounds per square inch along a body diagonal of the cubic crystal was found to orient the atomic spins perpendicular to the stress diagonal as indicated from susceptibility measurements. Annealing without stress or with stress along a crystal face, leads to an intermediate spin direction as indicated by isotropic susceptibility. Since NiO changes to a rhombohedral phase from a cubic form when the temperature is lowered through the Curie temperature, (643°K), the conclusion is that stress promotes the shortening of the stressed body diagonal and removes a degeneracy. If the logic is correct, NiO has its spins in the set of (111) planes perpendicular to the [111] direction which contracts when the crystal changes phase.

The CoO crystals exhibit two [100] directions of nearly temperature independent susceptibility, and one [100] direction of susceptibility increasing with temperature. Laue X-Ray patterns failed to identify the unique tetragonal axis because of the very slight distortion from the cubic form. Annealing with stress along one of the [100] directions led to slightly increased susceptibility in the

[010] direction but no conclusions were made regarding spin direction. Lower temperature (4.2°K) susceptibility measurements indicate that CoO has a paramagnetic contribution to its susceptibility even below the Curie temperature. 74 pages. \$1.50. Mic 56-2688

THERMAL CONDUCTIVITY OF POTASSIUM CHLORIDE CRYSTALS CONTAINING CALCIUM

(Publication No. 18,311)

Glen Alfred Slack, Ph.D.
Cornell University, 1956

The present experiment is an attempt to determine those factors which are important in explaining the observed thermal conductivity of an impure insulating crystal at low temperature. The previous experiments on pure crystals of several materials are in reasonable agreement with the theory. The status of impure crystals is, however, not as satisfactory.

In order to produce a single crystal with a measurable impurity concentration of a known kind, calcium chloride with radioactive calcium as a tracer was incorporated into otherwise relatively pure potassium chloride during the growth of the crystal from the melt. The divalent calcium produces vacancies in the lattice which act as point imperfections. The thermal conductivity of six crystals with different calcium concentrations up to 0.021 mole percent was measured from 3°K to 20°K by the use of a steady heat flow method. Two carbon resistance thermometers were employed to measure the temperature gradient along the crystal.

The results show that a pure potassium chloride crystal has a maximum thermal conductivity of about 7.2 watts/cm. deg. at 4.9°K. The thermal conductivity of the pure crystal should theoretically be a hundred times larger. The low value of the observed conductivity is thought to be caused by the presence of two naturally occurring isotopes in both potassium and chlorine. These isotopes produce a random variation in the masses at the points of an otherwise perfect lattice.

The crystals which contain the added calcium show a monotonically decreasing thermal conductivity with increasing impurity concentration over the whole temperature range. The temperature at which the maximum conductivity occurs shifts toward higher temperatures with increasing impurity concentration. The crystal with 0.021 mole percent calcium has a conductivity maximum of 1.2 watts/cm. deg. at 13.5°K. The effects to the added impurities can be explained by a combination of phonon scattering from pairs of associated calcium ions and potassium ion vacancies at temperatures above the maximum in the thermal conductivity curve, and scattering from small colloids of precipitated calcium chloride at temperatures below the maximum. The phonon scattering cross section of a potassium ion vacancy in potassium

chloride at low temperatures increases as the fourth power of temperature, and becomes equal to the geometrical cross section of the vacancy at a temperature of about one-fifth the Debye temperature.

230 pages. \$3.00. Mic 56-2689

A STUDY OF THE SPECIFICITY OF THE LONDON-VAN DER WAALS DISPERSION FORCE IN MOLECULAR AGGREGATES

(Publication No. 17,372)

Jerrold Moore Yos, Ph.D.
The University of Nebraska, 1956

Adviser: Herbert Jehle

Many biological processes show a remarkable specificity in that they are able to select accurately one out of a large number of possible end results. The purpose of the investigation reported here was to study the part played in specificity by the London-van der Waals dispersion force.

It was assumed that the different possible end results of the process correspond to different arrangements of the material in the system, and the arrangement for which the Helmholtz free energy is a minimum was determined, assuming that the entire interaction between the molecules is due to the London-van der Waals dispersion force. This was done in two steps: first the possible rearrangements of a molecular mixture were analyzed, and it was found that in the absence of steric effects all rearrangements could be expressed as a sum of elementary "quadruplet" rearrangements involving only four molecules; next a theorem was proved giving sufficient conditions for the association of like molecules to be preferred in a quadruplet system, and this theorem was applied to the dispersion force. In this way it was found that the action of the dispersion force tends to favor an arrangement in which molecules having the same structure are grouped together and oriented in such a way that in so far as possible each pair of neighboring molecules are rotated 180° relative to each other about a line joining their centers. This result does not depend on what type of molecules are involved; it holds for any molecule which can be described by a Hamiltonian.

Before this result can be applied to an actual specific process, it is necessary to know how strongly the arrangement described above is favored in that particular case, and whether there are other competing forces which may overshadow the effect of the dispersion force. In this connection it is pointed out that when molecules are close together forces due to the detailed distribution of electric charge in the molecule and to steric effects will ordinarily become more important than the dispersion force, while the latter will predominate at larger distances.

62 pages. \$1.50. Mic 56-2690

PHYSICS, ELECTRONICS AND ELECTRICITY
ELECTRIC CONDUCTION IN AN OIL-PUMPED
VACUUM SYSTEM

(Publication No. 17,175)

Ernest A. Bryant, Ph.D.
Washington University, 1956

Chairman: Joseph W. Kennedy

We have studied the leakage of electricity through a vacuum in an oil-pumped vacuum system. In this system the anode is charged to a high potential by the emission of beta particles from an internally mounted source. The maximum potential obtainable in this system (about 300 kilovolts) was limited by a flow of electrons, negative ions, and positive ions between the anode and cathode.

It is proposed that this leakage current is generated by two mechanisms, both involving the formation of positive ions in a film on the anode. We propose that electrons from the beta source produce most of the positive ions when the cathode is protected from the anode field by a negatively biased grid. We believe that an exchange type of mechanism, involving both electrons and negative ions, is responsible for the leakage current when the cathode is not protected by the grid. Under these conditions negative ions and electrons produced at the cathode flow to the anode and produce positive ions. The positive ions then pass to the cathode where they produce negative ions and electrons.

We found evidence that not all of the positive ions formed at the anode escape from its surface. The results of our experiments were best explained by an assumption that the ions escape from the anode surface by a process resembling evaporation. The evidence suggests that the positive ions which do not escape disappear by ion-recombination reactions.

A mass spectrometer was used to study the nature of the positive ions. We found that most of the ions were fragments of organic molecules. At the cathode an average 100-kev positive ion produced about 50 negative particles, mostly electrons. We conclude that drastic steps to eliminate sources of organic contaminants may result in higher limiting voltages. 107 pages. \$1.50. Mic 56-2691

IONIZATION BY POSITIVE IONS

(Publication No. 17,195)

David Eimon Moe, Ph.D.
Washington University, 1956

Chairman: Professor Robert N. Varney

Ionization of the noble gases by relatively low energy potassium ions has been investigated. A magnetic field rather than the usual electrostatic field is used to collimate the ionization electrons. The magnetic field also serves to suppress secondary electrons. The use of rela-

tively intense ion beams and phase sensitive detection of ionization signals yields a large increase in sensitivity over that obtained in former investigations.

The enhanced sensitivity permits detection of ionization at lower ion energies than heretofore reported. Evidence is presented for a real ionization threshold potential for K^+ in Kr.

The electron energy distribution of the ionization electrons is determined from stopping potential curves and is found to be characteristic of the bombarded gas. The maximum energy of the ionization electrons varies from 12 ev for Xe up to 20 ev for Ne. In general, the energy distribution of the ionization electrons is independent of the incident ion energy.

Both the absolute ionization cross section and its derivative with respect to ion energy are measured. The latter shows an unexpected "fine structure" which is characteristic of the bombarded gas.

The results of this investigation generally support the qualitative theory of ionization by ions proposed by Weizel. 89 pages. \$1.50. Mic 56-2692

ELECTRICAL CONDUCTION IN A
MERCURY-PUMPED VACUUM SYSTEM

(Publication No. 17,197)

Preston Vincent Murphy, Ph.D.
Washington University, 1956

Chairman: Joseph W. Kennedy

Voltage differences up to 500 kilovolts have been produced between concentric cylindrical or spherical electrodes. The charging current of 2×10^{-10} ampere consisted of beta particles emitted by a source on the anode. The currents which discharged the anode were investigated.

Spark discharge frequently occurred. It was found often to be associated with the quartz rod which supported the anode. The anode was more often discharged by a steady leakage current which flowed across the vacuum space. This current was reduced by a negatively biased cathode grid so that a higher voltage could be produced. With a grid the anode voltage was limited by field-assisted thermionic emission from the grid wires.

When leakage current flowed between anode and cathode, positive ions carried a fraction of the current. Mass-spectral analysis of the positive ions indicated that they were formed from organic compounds which were present on even the cleanest electrodes.

75 pages. \$1.50. Mic 56-2693

PHYSICS, NUCLEAR

INTERNAL BREMSSTRAHLUNG IN THE
CAPTURE OF μ^- MESONS BY NUCLEI

(Publication No. 17,177)

Robert Murray Cantwell, Ph.D.
Washington University, 1956

Chairman: Henry Primakoff

The shapes of the photon spectra of the internal bremsstrahlung associated with the radiative capture of μ^- mesons by light nuclei are calculated for the general beta decay interaction in terms of a number of nuclear matrix elements each independent of the energy of the photon. Explicit photon spectral shapes are obtained for the scalar and vector interactions. Approximate nuclear wave functions are used to predict the shapes of the spectra of photons emitted in the radiative capture of μ^- mesons by hydrogen, deuterium, tritium, helium³, and helium⁴. Methods are discussed for treating radiative capture by elements of large Z. It is concluded that, while the photon spectra in transitions to a given final state often depend quite appreciably on the type of the interaction, experimental detection of the dependence will be difficult because of the necessity of distinguishing between the various final nucleus states. More promising is the study of the shape of the spectrum of photons associated with the radiative capture of μ^- mesons by helium. Other possible experiments are also discussed.

66 pages. \$1.50. Mic 56-2694

STUDIES OF CRYSTAL GROWTH AND DISLOCATIONS

(Publication No. 17,603)

Robert Vincent Coleman, Ph.D.
University of Virginia, 1956

A research program was initiated and carried out to study the growth and dislocation properties of nearly perfect zinc crystals. This involved extensive work on the development of ultra-high vacuum distillation techniques in the range of vacuums of 5×10^{-9} mm of Hg. The growth of zinc crystals was carried out in both ultra-high vacuum and in atmospheres of hydrogen introduced into the growth chambers following high vacuum distillation.

In experiments carried out in hydrogen atmospheres studies were made of the growth of zinc whiskers and platelets. These were grown most successfully in hydrogen at a pressure of 600 mm of Hg and in temperature gradients on the order of 20°C per inch in the growth chambers. Whiskers up to 15 mm in length and with diameters from .1 to 10 microns were grown. Hexagonal, triangular, and rhombohedral platelets up to several millimeters in diameter were grown under the same conditions. Both whiskers and platelets showed very high strength properties. Whiskers grown by this method have elastic limits on the order of 1000 times greater than

ordinary zinc crystals. Nucleation and growth experiments were carried out in high vacuum pyrex growth chambers in order to develop methods of growing high purity nearly perfect crystals free from absorbed and adsorbed impurities.

Under a second program of work the dissolution of thin plates of cadmium iodide was studied. This involved a qualitative study of the nucleation of pits at dislocations under very low undersaturations. The results show conclusively that pits open up spontaneously at dislocations of large Burgers' vectors when exposed to low undersaturations.

58 pages. \$1.50. Mic 56-2695

MESON PRODUCTION BY ELECTRONS IN HYDROGEN

(Publication No. 18,125)

Richard Bertram Curtis, Ph.D.
University of Illinois, 1956

The differential cross section for the production of mesons by electrons on hydrogen has been calculated to first order in the fine structure constant as a function of the meson angle and energy. It is possible to split the transition probability into two terms, one of which is proportional to the Photo-meson differential cross section (the Williams-Weizsäcker approximation), the other containing longitudinal current and other corrections. Experimental cross sections were used in the first term and the correction term was calculated using the Chew-Low theory. The cross section was calculated on the Illiac (the electronic computer at the University of Illinois) for seven electron energies from 350 Mev to 560 Mev, for meson energies at intervals of 15.5 Mev, and for meson laboratory angles of 45°, 90°, and 180°. A comparison is made with experiment.

41 pages. \$1.50. Mic 56-2696

PION PRODUCTION IN PION-NUCLEON SCATTERING

(Publication No. 18,135)

Jerrold Franklin, Ph.D.
University of Illinois, 1956

The cross section for the production of one additional pion in a pion-nucleon collision has been calculated using the Chew-Low theory of P-wave pion-nucleon interaction.¹ The transition matrix element for the scattering of one meson into two mesons is defined in terms of exact eigenstates of the total hamiltonian and an integral equation is obtained by expanding in a complete set of eigenstates. Limiting the sum over states to include only physical nucleon (no real mesons) states results in an expression for the one to two meson matrix element as a product of an elastic scattering matrix element and a meson emission matrix element. The experimental elastic scattering phase shifts were used in calculating the two meson cross section. The results of this calculation have been used to

estimate the effect of two meson states on the Low equation for elastic scattering. The contribution to the effective range for elastic pion-nucleon scattering is small.
46 pages. \$1.50. Mic 56-2697

I. G. F. Chew and F. E. Low, Phys. Rev. 101, 1570 (1956).

TOPICS IN NUCLEAR STRUCTURE

(Publication No. 17,187)

Paul Goldhammer, Ph.D.
Washington University, 1956

Chairman: Professor E. Feenberg

The coupling of nucleon orbitals through the mediation of surface waves has been treated by the intermediate coupling procedure, considering only 0, 1, and 2 surfons. A single-nucleon description appropriate for $^{14}\text{Si}_{15}$ and $^{15}\text{P}_{14}$, and a three-nucleon description with $T = 3/2$ appropriate for $^{14}\text{Si}_{17}$ and $^{17}\text{Cl}_{20}$ (3 proton holes) are considered. $2s_{1/2}$ and $1d_{3/2}$ orbitals are coupled in this region. $(2s_{1/2})^2$, $(1d_{3/2})$, $(2s_{1/2})(1d_{3/2})^2$, and $(1d_{3/2})^3$ configurations are coupled in the three-nucleon system. Gamow-Teller and M1 matrix elements between $I = 3/2+$ and $I = 1/2+$ states are small but not 1-forbidden as they are for pure $1d_{3/2} \rightarrow 2s_{1/2}$ transitions. The correction to the $\mu_{1/2}$ Schmidt line in $^{14}\text{Si}_{15}$ is about one-half the experimental deviation; while the correction to the $\mu_{3/2}$ moment for $^{17}\text{Cl}_{20}$ is 0.788, compared to 0.552 observed. Similar calculation for three-nucleon systems with $T = 1/2$ yield results applicable to $^{15}\text{P}_{16}$ and $^{18}\text{A}_{19}$. The coupling of $1g_{7/2}$, $2d_{5/2}$, $2d_{3/2}$, and $3s_{1/2}$ proton orbitals in $^{51}\text{Sb}_{70}$ and $^{51}\text{Sb}_{72}$ is treated by a single-nucleon description. The electric quadrupole moments of both $^{51}\text{Sb}_{70}$ and $^{51}\text{Sb}_{72}$ are accounted for and an appreciable M1 matrix element is found for the "1-forbidden" transition $5/2+ \rightarrow 7/2+$ in $^{51}\text{Sb}_{72}$.

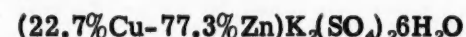
The α -particle is known to possess no excited states in the discrete spectrum. Exchange forces can not support an excited state of the α -particle; but a nuclear interaction with a repulsive core tends to pull the energy of an excited P state down toward the discrete spectrum. The present study attempts to estimate the magnitude of this effect, employing a second-order perturbation calculation under conditions considered most favorable to the existence of a bound P state. It is found that the energy of the excited P state is steadily pulled down as the magnitude of the repulsive core is increased. The effect, however, is not great enough to require the rejection of a repulsive core in the nuclear interaction, especially since the case considered was most favorable to pulling down the energy of the P state.
72 pages. \$1.50. Mic 56-2698

NUCLEAR ORIENTATION OF COBALT ISOTOPES

(Publication No. 18,141)

David Francis Griffing, Ph.D.
University of Illinois, 1956

A report is given of three nuclear orientation experiments performed on the radioactive isotopes Co^{58} and Co^{60} . In each experiment the radioactive constituent was grown in single crystals of



and cooled using the technique of adiabatic demagnetization.

Co^{58} decays by K-capture and positron emission to the .805 Mev energy level in Fe^{58} and by K-capture to the 1.6 Mev energy level in Fe^{58} . The radioactive Co^{58} was cooled to .012°K by a two-stage adiabatic demagnetization technique, and the .805 Mev and 1.6 Mev gamma ray counting rates were observed at three angles as functions of the paramagnetic susceptibility of the crystals. The radioactive results are (1) the 1.6 Mev gamma ray has multipolarity two (2) the beta interaction to the 1.6 Mev energy level in Fe^{58} is characterized by $\lambda = .45 \pm .11$ and (3) the beta interaction to the .805 Mev energy level in Fe^{58} is characterized by $\lambda = .11 \pm .04$, where λ is a parameter related to the mixture of Fermi and Gamow-Teller interactions in the beta decay. In addition to the radioactive information, the .805 Mev counting data was used with the paramagnetic resonance data to determine the absolute temperature dependence of the paramagnetic susceptibility. The results can be expressed approximately in terms of a Curie-Weiss law with a Curie-Weiss $\Delta = +.009^\circ\text{K}$. The experimental deviations of the susceptibility from Curie's law are in agreement with those calculated on the basis of the hfs interaction, a weak magnetic dipole-dipole interaction, and a strong antiferromagnetic exchange interaction between paramagnetic ions.

Co^{60} decays by negatron emission to the 2.5 Mev energy level of Ni^{60} which then decays to the ground state by emission of two successive gamma rays. The radioactive Co^{60} was cooled to .03°K by adiabatic demagnetization and the counting rates of these two gamma rays observed separately as functions of the paramagnetic susceptibility. According to any of the decay schemes 5,4-4-2-0 these two gamma rays should have the same dependence on the susceptibility, and the experimental results show this to be the case.

Radioactive Co^{58} and Co^{60} were grown in the same single crystals and cooled to .03°K by adiabatic demagnetization. The counting rates of the .805 Mev gamma ray in Co^{58} and of the 1.33 Mev gamma ray in Co^{60} were observed as functions of the paramagnetic susceptibility. In this way a determination of the ratio of the magnetic moments of Co^{58} and Co^{60} could be made which depended on the assumed decay schemes. Assuming a 2-2-0 decay for Co^{58} with a value of $\lambda = .11$, and a 5-4-2-0 decay for Co^{60} , the ratio of the magnetic moments of Co^{58} and Co^{60} was found to be $1.06 \pm .03$.

83 pages. \$1.50. Mic 56-2699

**A FAST-PARTICLE COUNTER UTILIZING
CERENKOV RADIATION FROM A
GASEOUS DIELECTRIC**

(Publication No. 17,360)

Roger James Hanson, Ph.D.
The University of Nebraska, 1956

Adviser: Donald C. Moore

A detector sensitive to only very energetic charged particles would be useful to study the energy spectrum and nuclear interaction cross-sections of high energy (>5 Bev) cosmic-ray protons. A counter has been built which is sensitive only to charged particles with very high velocities. The counter utilizes Cerenkov radiation which is produced by the particle as it moves in a gaseous dielectric medium with a speed v greater than that of light in the medium. Radiation is emitted only if $v > c/n$, where n is the optical index of refraction, and c is the velocity of light in vacuum.

Performance of the counter has been tested with CO_2 gas at 13.1 atmospheres absolute pressure. CO_2 has an index of 1.00569 at this pressure. The efficiency for counting cosmic-ray mu-mesons with $v > c/n$ ($E > 0.9$ Bev) was measured to be $(86 \pm 2)\%$. Values of 3-4% were obtained in tests intended to measure the efficiency for counting mu-mesons with $v < c/n$; ideally the efficiency should be zero for these mu-mesons. At least part, and perhaps all, of the 3-4% is due to electrons and protons with $v > c/n$.

108 pages. \$1.50. Mic 56-2700

ELASTIC SCATTERING OF 15-MEV NEUTRONS

(Publication No. 17,617)

Patrick Joseph Kenny, Ph.D.
University of Virginia, 1956

In order to study the applicability of the Feshbach, Porter, Weisskopf (Phys. Rev. 96, 448 (1954)) "cloudy crystal ball" model of the nucleus at intermediate energies, the scattering of 15-Mev neutrons by various targets was undertaken. This energy was chosen, because it is high enough so that compound elastic scattering can be ignored and the experimental results more easily compared with the predictions of the theory.

Utilizing the University of Virginia Van de Graaff electrostatic accelerator as a source of accelerated deuterons, neutrons were produced in the $\text{T}(d,n)\alpha$ reaction. "Electronic collimation" of the beam of neutrons was secured by counting only neutrons in coincidence with α 's in an arbitrarily chosen direction. The neutron beam so defined was then scattered by a target, and the scattered neutrons were counted by a neutron detector whose bias was set to reject those neutrons inelastically scattered. Gamma rays from inelastic neutron scattering in the target were rejected because of their shorter flight time, whereas background neutrons scattered by the walls were rejected because of their longer flight time.

The data obtained for aluminum and lead scatterers have been compared with the original optical model and a few of its subsequent modifications.

65 pages. \$1.50. Mic 56-2701

**A STUDY OF NUCLEAR STRUCTURE
THROUGH ALPHA-PARTICLE SCATTERING**

(Publication No. 17,129)

Donald Duane Kerlee, Ph.D.
University of Washington, 1956

Observations have been made of the alpha-particle spectra resulting from the bombardment of elemental foils by alpha particles of selected energies in the range 13 to 44 Mev from the University of Washington 60-inch cyclotron. Elastic scattering from Cu, Zn, Rh, Ag, Sn, Sb, Ba, La, Ce, Pr, Sm, Eu, Tb, Er, Lu, Ta, Au, Pb, Bi, Th, U, Np and Pu has been evaluated by the Blair model to obtain interaction radii. A value of $R_{A\alpha} = (1.39 \pm 0.05)A^{1/3} + (2.29 \pm 0.20)$ ($R_{A\alpha}$ in fermis) fits the data with an average deviation of 0.8 per cent and a maximum deviation of 3.3 per cent. Measurements were made of a parameter related to the shape of the elastic cross section curves in an attempt to measure the diffuseness of the nuclear surface. A qualitative discussion is given. Relative intensities of alpha groups corresponding to elastic scattering and inelastic scattering with excitation to the 2.43-Mev level in Be^9 were measured. Indication of an inelastic group at $Q = -3.1$ Mev was observed but the evidence is not clear. Significant contribution from the $Q = -1.8$ Mev group is excluded. Inelastic scattering with excitation to the 2.62-Mev level in Pb^{208} was measured in an angular distribution study. A monotonic behavior was observed for the cross section as a function of angle. Areas for further study are discussed.

129 pages. \$1.75. Mic 56-2702

**TEMPERATURE DEPENDENCE
OF POSITRON LIFETIMES IN SOLIDS AND LIQUIDS**

(Publication No. 17,618)

Hugh Stevenson Landes, Ph.D.
University of Virginia, 1956

Annihilation with an electron, accompanied by electromagnetic radiation, is the ultimate fate of all positrons. Positron lifetimes, which have been observed to vary from 10^{-7} sec. in some rarefied gases to 10^{-10} sec. in solids and liquids, are affected by the annihilation mechanism; i.e. positrons can annihilate as free particles or from the bound state called positronium. Metals have been found to exhibit the same lifetime of 1.5×10^{-10} sec. to within 0.7×10^{-10} sec. Positron lifetimes in good crystalline nonmetals vary from 2×10^{-10} to 3×10^{-10} sec., whereas some amorphous solids and liquids exhibit a complex lifetime. The complex life time has been interpreted as a composite of two lifetimes, a τ_1 or short lifetime of the same order of magnitude as for metals and a τ_2 or anomalous lifetime that is approximately ten times greater than τ_1 . The percentage of positrons annihilating with the τ_2 lifetime is of the order of 10 - 30%.

The long lived or anomalous lifetime in amorphous materials has been found to depend upon magnetic fields and temperature. The purpose of this experiment has been to measure positron lifetimes in some solids and liquids as a function of temperature and phase change with the hope that a better understanding of these thermodynamic parameters that influence positron behavior will

add to our knowledge of solid state physics.

Measurements of positrons annihilating directly in liquid nitrogen yielded no τ_2 lifetime, only a short lived τ_1 component of $(3.02 \pm .3) \times 10^{-10}$ sec. An anomalous or τ_2 lifetime of $(2.35 \pm .2) \times 10^{-9}$ sec. was obtained for positrons annihilating in liquid helium.

The results for positron annihilation in Teflon at 4.2°K , 77°K , and 300°K and the accompanying theoretical explanation suggest that the τ_2 lifetime does not decrease linearly with temperature (as formerly thought), but more probably as follows:

$$\tau_2(T) = \tau_2(0) [1 + AT^{3/2} e^{-T_0/T}]$$

where $\tau_2(0)$ is the lifetime obtained at 4.2°K and T is the Kelvin temperature.

P type, N type, and pure specimens of germanium were found to exhibit the same short τ_1 lifetime of 3.6×10^{-10} sec. to within 8.4×10^{-11} sec. No τ_2 component was observed.

The effect of phase change upon positron behavior was observed by determining lifetimes of positrons annihilating in the organic crystal, naphthalene, whose melting point is 80.2°C . Measurements were made at temperatures ranging from 25°C to 100°C . The τ_2 lifetime remained constant from room temperature up to 6°C below melting at which point it began increasing rather sharply and continued rising with temperature until it reached a value $2\frac{1}{2}$ times the room temperature value in the liquid phase. The number of positrons annihilating with the τ_2 lifetime was found to triple at the phase change quite sharply. The data suggest a strong correlation between positron behavior in naphthalene and the amount of order (vs disorder) in the naphthalene crystal. It appears the triplet to singlet conversion rate decreases as the naphthalene becomes more disordered, thereby giving a longer τ_2 lifetime. Furthermore, the capture cross section of positrons annihilating with the long lifetime apparently increases with the amount of disorder present in the naphthalene.

95 pages. \$1.50. Mic 56-2703

THE PHOTOPRODUCTION OF CHARGED PI-MESONS FROM COMPLEX NUCLEI

(Publication No. 17,005)

Kirk Warren McVoy, Jr., Ph.D.
Cornell University, 1956

Experimental studies of the photoproduction of charged pions from heavy nuclei have made clear the influence of specifically nuclear effects on the size of the meson yields. The present investigation is an attempt to analyze these effects in terms of a simple phenomenological theory of the nucleus, using the impulse approximation; it is assumed that the production cross section from nucleons within the nucleus can adequately be represented by the measured cross section from free nucleons. Because the yields depend quite critically on the experimental conditions employed, the analysis was carried out only for the conditions used in the experiment of Littauer and Walker (Phys. Rev. 86, 838), in which 65-Mev charged pions were selected at 135° to the Bremstrahlung beam.

The two principal nuclear effects are: (a) The total yield of charged mesons per nucleus, $Y^+ + Y^-$, varies quite accurately as $A^{2/3}$; (b) The ratio Y^-/Y^+ varies considerably from nucleus to nucleus, but shows a strong correlation with the binding energy of the nucleus. Specifically, if M_Z is the ground-state mass of the target nucleus, and M_{Z-1} and M_{Z-2} those of the isobars which result from the formation of π^+ and π^- mesons, Littauer and Walker found that Y^-/Y^+ is proportional to $M_{Z-1} - M_{Z+1}$, i.e. the more strongly the final-state isobar is bound, relative to the target isobar, the greater is the yield.

The proposal is made that this latter correlation can be explained simply in terms of different "threshold" energies for π^+ and π^- production. That is at least the energy $M_{Z-1} - M_Z$ must be given up to the nucleus in order to create a π^+ meson, so the lowest gamma-ray energy which can create a meson of total energy k_0 is $k_0 + (M_{Z-1} - M_Z)$. Thus the smaller $M_{Z-1} - M_Z$, i.e., the tighter the binding of the final-state isobar relative to the target nucleus, the greater is the contributing range of gamma-ray energies, and the larger is the yield.

The importance of this effect is enhanced by an additional consideration suggested originally by Chew and Steinberger. The short-range spatial correlations of nucleons in the nucleus, due to the effect of the Pauli Principle in coordinate space, make the nucleus especially reluctant to change the charge of one of its nucleons, and generally requires an expenditure of an additional amount of energy, V_0 , whenever such a change takes place.

If these concepts are incorporated into the impulse-approximation description of the production process, it is found that the $-/+$ effect can quite adequately be accounted for by choosing $V_0 = 42$ Mev.

Because the meson-nucleon scattering cross section is quite large for mesons in the 100-Mev range which is relevant here, scattering and absorption within the production nucleus itself also affect strongly the observed energy and angle distribution of produced mesons. In lieu of a complete Monte Carlo calculation of such effects, an attempt was made to estimate their magnitude roughly on the basis of a simple multiple-scattering calculation. The principal result was that, for medium-A nuclei, about half of the observed mesons would have come indirectly from production at an energy higher than 65 Mev, followed by a scattering down to the proper energy. When this scattering is taken into account, it appears to lower the choice of V_0 to about 28 Mev.

102 pages. \$1.50. Mic 56-2704

LOW-LEVEL SCINTILLATION COUNTING WITH APPLICATION TO CARBON-14 MEASUREMENT

(Publication No. 17,577)

Edward Paul Palmer, Ph.D.
University of Utah, 1956

Chairman: Thomas J. Parmley

The problems involved in using scintillation counters for making measurements of low-level nuclear radiation were investigated experimentally. A counting system employing fast coincidence-timing techniques was developed and applied to the problems of reducing background and

increasing the detection efficiency in such measurements.

The system was designed specifically to eliminate that part of the background counting rate which had been attributed to light flashes in the photomultiplier tubes. It was found that such light-flash-produced pulses are not a significant factor in a low-level scintillation counter and that all the effects attributed to this cause can be explained by effects from local radioactive contamination and from cosmic rays.

In making measurements of carbon-14 in a liquid scintillating cell, a detection efficiency of 40 to 65 per cent was attained with a background counting rate of 100 to 250 per minute. With the scintillator and photomultiplier tubes used here, a maximum possible efficiency of 70 per cent was indicated. From investigation of the sources of background and of the differences between the pulse size spectrum of background and carbon-14, methods for background reduction are suggested. Based on the requirement that the counting rate of sample minus background is four-times the standard deviation of the background rate, the system described is able to do radiocarbon dating of materials which are 44,000 years old.

78 pages. \$1.50. Mic 56-2705

THE PRODUCTION AND SCATTERING OF POLARIZED ELECTRONS

(Publication No. 17,625)

William Gower Pettus, Ph.D.
University of Virginia, 1956

An investigation has been carried out in order to determine whether or not the polarization of electrons by nuclear single scattering is predicted correctly by the Mott theory. A double scattering experiment was carried out in which a partially polarized beam of electrons was produced by the first scattering as evidenced by an azimuthal asymmetry in the distribution of the second scattered electrons.

These experiments have been carried out in the energy range from 80 to 200 kilovolts and for scattering angles of 60, 90, and 120 degrees. The degree of polarization produced by scattering from gold foils (0.16 mg/cm^2) was determined relative to that produced by scattering from aluminum (1.8 mg/cm^2). This procedure of normalizing the observations for gold to those for aluminum allowed the effects of instrumental asymmetries to be minimized.

The results show clearly a polarization effect and its magnitude is considered in satisfactory agreement with the theory for energies above 120 kilovolts. Below 120 kilovolts the measured asymmetries are definitely low and seem to follow the trend observed by Ryu. The observed angular dependence of the polarization asymmetry appears to confirm the recent calculations of Mohr and Tassie which indicate increased asymmetries for angles larger than 90 degrees. 44 pages. \$1.50. Mic 56-2706

THE PHOTOELECTRIC CROSS SECTION OF LEAD FOR 0.511 MEV GAMMA-RAYS

(Publication No. 18,286)

Karl William Seemann, Ph.D.
Cornell University, 1956

The K shell photoelectric cross section of lead has been measured directly using annihilation radiation from a positron source (Na^{22}). One NaI(Tl) scintillator viewed the source, counting 0.511 Mev gamma-rays. A lead foil target was placed on the opposite side of the source at 180° to the gamma-ray counter. The target subtended a larger solid angle than the counter so as to intercept any annihilation quantum whose "twin" was detected in the counter. A coincidence was taken between the gamma-ray counter and another NaI(Tl) scintillator at 90° to the beam in which 75 Kev K x-rays from the target were detected. The efficiency of the x-ray counter was measured by using Hg^{203} as a source of x-rays. The beta particle and conversion electron were detected in coincidence in two thin stilbene crystals and a triple coincidence was formed with the K x-ray. The measured cross section was $\sigma_K = 23.4 \pm 0.7$ barns in agreement with theory.

59 pages. \$1.50. Mic 56-2707

A HIGH ENERGY INTERFERENCE EFFECT OF BREMSSTRAHLUNG AND PAIR PRODUCTION IN CRYSTALS

(Publication No. 18,290)

Herbert Überall, Ph.D.
Cornell University, 1956

With the use of monocrystalline targets for bremsstrahlung and pair production experiments, interference phenomena are expected to occur, which will markedly change the γ ray spectrum as well as the pair energy distribution, for certain angles of incidence giving enhancement of radiation and pairs. This can be seen as follows: using the Weizsäcker-Williams method,¹ bremsstrahlung corresponds to a Fourier component in the equivalent photon spectrum of the atomic Coulomb field being Compton scattered by the electron in a Lorentz frame in which the electron is at rest. Photons with wavelengths larger than the Compton wavelength will be scattered. If a series of atoms passes the electron, the spacing of the atoms will be decreased by the Lorentz contraction, so that above a certain threshold energy, the wavelength of the equivalent quantum becomes larger than the effective spacing, and coherence of the radiation from several atoms will occur. Another method consists in showing that the total cross section can be represented by an integration of the Bethe-Heitler formula¹ over q -space, and by observing that the main contribution comes from a pancake-shaped region of width mc and thickness δ in q -space, with the direction of the primary as axis; δ is the minimum momentum transfer q_{\min} , being of order

$$mc(mc^2/E_{\text{prim}}).$$

In a crystal, the integration over q -space gets replaced by a summation over the reciprocal lattice, and if the

pancake thickness becomes smaller than the reciprocal lattice constant $2\pi h/a$ by a factor $n_0 \sim 2$ or 3, variations of the cross section with angle of incidence ϑ ($= \angle$ primary particle, line of atoms) will occur, besides an enhancement. The temperature motion of the atoms is also considered; it reduces the interference effect to some extent by dividing the cross section into an isotropic part of about 80% of the Bethe-Heitler cross section, and an interference part. For the quantitative calculation, we used Born approximation and obtained the following results. Threshold energy is ~ 200 Mev for bremsstrahlung, ~ 1 Bev for pair production. Interference is confined to angles of order $(a_{\text{screen}}/\lambda_C)(mc^2/E_{\text{prim}})$. The cross section can be written as

$$\sigma_{\text{pair}} = N \frac{Z^2}{137} \left(\frac{e^2}{mc^2} \right)^2 \frac{dE_+}{k^3} \{ (E_+^2 + E_-^2) [\psi_1^C(\delta) + \psi_1^0(\frac{\vartheta}{\delta}) + \sum_{h>0} \psi_1^h(\delta, \vartheta)] + \frac{2}{3} E_+ E_- [\psi_2^C(\delta) + \psi_2^0(\frac{\vartheta}{\delta}) + \sum_{h>0} \psi_2^h(\delta, \vartheta)] \}$$

with k = photon energy, E_+ = pair energy, $\delta = m^2 c^3 / 2E_+ E_-$, and similarly for bremsstrahlung. Numerical calculations were performed for Cu, diamond, and Pt at $T = 0^\circ$ and 77° . For Cu at $T = 0^\circ$, and bremsstrahlung at 1 Bev, the radiation below 200 Mev is enhanced by at least a factor 2 at angles of the order given above, but it becomes slightly smaller than the Bethe-Heitler cross section at very small and very large angles. Pair production at 5 Bev is enhanced by a factor 1.5 for nearly equal energy distribution of the pair.

69 pages. \$1.50. Mic 56-2708

1. W. Heitler, *The Quantum Theory of Radiation*, 3rd ed., Oxford, Clarendon Press, 1954.

PHYSICS, SOLID STATE

THE HALOGEN BAND IN SODIUM CHLORIDE

(Publication No. 18,119)

Russell Carl Casella, Ph.D.
University of Illinois, 1956

It has been suggested by Parratt and Jossem¹ that the halogen band in NaCl may be considerably narrower than 4.4 ev, as predicted by Shockley.² To obtain a lower limit on the width of the band, a model is assumed in which the Cl^- ions in the Cl^- - Cl^- lattice for NaCl are imagined replaced by neutral argon atoms. The crystal potential is assumed to be a sum of spherically symmetric atomic potentials, which are calculated in the free-electron-exchange approximation of Slater.³ The method of tight binding is employed. The wave function is expressed as a linear combination of Bloch sums of 3p orbitals with x, y, and z symmetry. The secular equation has been factored in the two-center, nearest-neighbor approximation, for k along the (100), (110), and (111) directions. The energy integrals are calculated analytically. A minimum band width of about 1.0 ev is obtained. The error due to neglect of three-center integrals, non-orthogonality of Bloch sums, second-nearest neighbors, and the influence of the 3s band is estimated to be of order 30%. The actual value of the width is believed to lie much closer to Shockley's result, which probably represents an upper limit since his calculation is based upon Hartree orbitals determined without exchange. 94 pages. \$1.50. Mic 56-2680

1. L. G. Parratt and E. L. Jossem, *Phys. Rev.*, **97**, 916 (1955).

2. W. Shockley, *Phys. Rev.*, **50**, 754 (1936).

3. J. C. Slater, *Phys. Rev.*, **81**, 385 (1951).

PHYSIOLOGY

STUDIES OF THYROID GLAND FUNCTION
IN RATS EXPOSED TO COLD

(Publication No. 17,120)

Merva Kathryn Cottle, Ph.D.
University of Washington, 1956

The thyroid response to varying durations of cold (5°C) exposure was studied in male Sprague-Dawley and Wistar rats by measuring biologic decay of radioiodine, 24-hour conversion ratios, thyroidal I^{131} content at four hour intervals (4-24 hours) after intraperitoneal injection of carrier-free I^{131} , and thyroid weights. Radioiodine was released more rapidly from thyroid glands of rats maintained at 5°C for 7, 14, and 35 days than from thyroids of controls kept at 26°C . After 60 and 180 days' exposure, rate of release was somewhat slower than during early exposure, but remained more rapid than that for controls. The percentage of serum I^{131} in the protein-bound form 24 hours

after injection was also increased after one weeks' exposure and remained higher than control values when measured after 60 days' exposure. In agreement with results of other authors, both gland weight and I^{131} content were found to increase during early exposure and to return to approximately control levels after 60 days' exposure.

Since biologic decay and conversion ratios are more direct measures of thyroid hormone secretion than gland weight and I^{131} content, the results indicate that turnover of hormone is not only elevated during initial exposure but is maintained at a higher level after rats have been subjected to 5°C for long periods. This is contrary to previous conclusions based upon gland weight, I^{131} content, and other indirect indices which have suggested that thyroid function increases only during early exposure and returns to control levels after 60 days.

67 pages. \$1.50. Mic 56-2709

THE EFFECTS OF X-RAYS ON THE BIOSYNTHESIS OF TOBACCO MOSAIC VIRUS

(Publication No. 17,185)

Alonzo James Fairbanks, Jr., Ph.D.
Washington University, 1956

Chairman: Dr. Barry Commoner

This study was undertaken to discover significant effects of irradiating with X-rays on the synthesis of tobacco mosaic virus (TMV). These effects when found were studied in detail in subsequent experimentation.

Leaves of *Nicotiana tabacum* were used as host material for the synthesis of the virus. This material was inoculated with virus, cultured in the form of leaf disks under constant conditions of lighting and temperature and irradiated at a given time during culture. Virus analyses were made at certain periods following irradiation. Intact young leaves and whole plants were used in certain phases of the irradiation studies.

To facilitate certain aspects of these studies, attempts were made to devise a bioassay system for quantitatively detecting and identifying biologically a small quantity of virus in solution. In these attempts leaves of both *Nicotiana tabacum* and *Nicotiana glutinosa* were utilized.

The data included were derived from experiments undertaken over a three year period.

Results were obtained which showed a characteristic effect of X-rays in markedly inhibiting subsequent synthesis of TMV in tissue irradiated during the sensitive period. This sensitive period occurs 80 to 120 hours after inoculation, shortly before any significant amount of virus can be extracted from the tissue. A particularly effective X-ray dose was discovered for this inhibition. Areas of unusually rapid virus synthesis were observed. These appeared in irradiated tissue as yellow circular spots. No satisfactory bioassay system was devised for the quantitative detection of small amounts of virus.

From this research it can be concluded that X-rays generally suppress the synthesis of TMV. X-rays also cause the appearance of small, circular yellow areas in which unusually rapid synthesis of a mutant form of TMV occurs and in which a substantially higher final virus content is attained than in the surrounding tissue. Superposition of the two effects of general virus suppression and unusually high virus content in yellow spots can lead to the observed minimum of virus content of the virus-dosage curve.

107 pages. \$1.50. Mic 56-2710

A STUDY OF THE RENAL TRANSPORT MECHANISMS FOR INORGANIC PHOSPHATE

(Publication No. 17,533)

Richard Lester Malvin, Ph.D.
University of Cincinnati, 1956

It has been demonstrated that the renal capacity to reabsorb inorganic phosphate is depressed if the plasma CO_2 concentration is increased to such a level that bicarbonate is excreted in the urine. That this situation was not the result of alkalosis per se was demonstrated by the infusion of "Diamox". This agent caused a mild acidosis, and yet at the same time depressed phosphate reabsorption. Moreover, since "Diamox" also caused a decrease in the total reabsorption of bicarbonate these results appear to be explicable only on the assumption that bicarbonate may be reabsorbed by two different mechanisms.

The first, and possibly major pathway is one involving carbonic anhydrase. The second pathway is one in which bicarbonate is reabsorbed as such. It is along this second pathway that bicarbonate competes with phosphate for reabsorption. This assumption was given more weight by the findings that Tm phosphate was depressed by respiratory alkalosis or by raising the bicarbonate and CO_2 levels of the plasma in such a way as to maintain the blood pH at the control level.

In order to determine the cellular mechanisms responsible for the competition, comparisons were made between the ability of guinea pig kidney homogenates to esterify inorganic phosphate in vitro and the ability of phosphate loaded dogs to maximally reabsorb filtered phosphate. The results of such experiments have shown that various substances which inhibit esterification of inorganic phosphate in vitro also depress Tm phosphate when infused into dogs. Thus it was interesting to note that the presence of bicarbonate in kidney homogenates reduced their ability to esterify inorganic phosphate, independently in the slight change in pH of the medium.

Some other substances studied were: 2,4-dinitrophenol, methylene blue, sodium malonate. Kidney homogenates incubated in the presence of any of these substances exhibit a marked reduction in the rate of disappearance of inorganic phosphate from the medium. If they are infused into phosphate loaded dogs they all depress Tm phosphate. The results seem to indicate that at some point in its renal transport phosphate must be esterified, as evidenced by the fact that certain agents which uncouple oxidative phosphorylation, or which inhibit oxidation, also depress the rate of renal transport of inorganic phosphate.

58 pages. \$1.50. Mic 56-2711

POLITICAL SCIENCE

POLITICAL SCIENCE, GENERAL

INTEREST GROUPS IN ACTION: A CASE STUDY OF OREGON MILK CONTROL, 1933-1954

(Publication No. 17,116)

Donald Gordon Balmer, Ph.D.
University of Washington, 1956

This is a case study exploring the nature of the political process. The public policy involved - production and price control of the fluid milk industry in Oregon - was an important one involving an industry of general interest and one in that nebulous category proclaimed "affected with a public interest." During the twenty-one year period, 1933-1954, all phases of the political process and the several institutions of government were involved, hence this case study supplies material for general observations on the governmental process not generally available.

The understanding of the dynamics of the public policy involved requires the identification of the main groups concerned. The elements of the fluid milk industry provided a point of departure: producers, producer-distributors, distributors, retailers (grocers), and consumers. Each of these categories was composed of numerous groups, some of which combined several functions hence overlapped the several categories. For example, the distributor category contained: producer cooperatives, national dairy chains, grocery chains, and local distributors, as well as producer-distributors. Thus the groups involved were numerous and ever-changing. Furthermore, there were countless coalitions often forming temporary catalytic groups. Also, recognition was given the role of administrators and the activities of non-dairying groups.

These several groups attempted to advance what they understood to be their respective interests by using the economic and political means at their disposal. Generally they sought to make advantageous use of the access they enjoyed to the various governmental institutions. Quantitatively the bulk of this case study emphasizes the ensuing twenty-one year struggle. The producers enjoyed access to the rurally overrepresented state legislature from whence they secured the 1933 milk control law. This legislative influence resulted in effective access to the administration which always supported the law it was administering. This held true even though four different administrative structures were employed. During this period the judiciary tended to sustain legislative pronouncements. Thus the organized producers, often aided by the large distributors, had substantial access. The dissident elements, primarily a grocer chain and sporadically active consumers, had little success on either the legislative or administrative levels. Although the courts were utilized, only after the war were these efforts somewhat successful. The predominantly urban centered dissidents did have an advantage in a direct vote on an initiative. However, for numerous reasons, two initiatives failed. The repeal initiative of 1954 was not sponsored by the chains or the con-

sumers and succeeded more because the major elements supporting control ceased to agree than because of the homely, low-pressure campaign of a small, unlicensed producer. The chronological section of this thesis is divided by the three initiative campaigns, for during these conflicts the proponents and opponents were best identified.

The findings of this case study re-emphasize the importance of groups in shaping public policy. Recognition of the constantly changing context and the changing nature of the groups therein must be given. Emphasis was also placed on the impact of individual personalities upon group actions. Certain exceptions to the assumed economic basis of groups had to be made in view of the sustained consumer activity.

This study further suggested the existence of a "cyclic search for access". The cycle was that of dominant groups defending their advantage when threatened, and struggling among themselves when in arenas safe from would-be repealers. Meanwhile the dissidents were forced to move from institution to institution in an unsuccessful search for relief. The emergence of this pattern was facilitated by the selection of a case study involving the several institutions of government over a prolonged period of time.

358 pages. \$4.60. Mic 56-2712

THE SEPARATION OF THE FARM BUREAU AND THE EXTENSION SERVICE AS A POLITICAL ISSUE

(Publication No. 18,113)

William Joseph Block, Ph.D.
University of Illinois, 1956

This is a study of the efforts of two opposing groups, identified by their respective methods and goals, to abolish or to perpetuate the arrangements whereby some county farm bureaus had varying degrees of financial or supervisory responsibility for the program of the Cooperative Extension Service. It covers the period from 1939, when farm bureaus were formal sponsors in fifteen states, through 1955, when they held such positions in only five.

The activities of the participants centered about their efforts to influence the decisions of government officials in behalf of their respective causes. Such efforts formed the raw materials for this study.

One conclusion reached is that intensity of activity about an issue is greatest when organizations are in direct conflict. The major moves to separate the farm bureaus from the Extension Service came into existence as a means of countering Farm Bureau efforts to influence governmental policy. When either a state or the national Farm Bureau provided leadership in any controversy, opponents seized upon the argument that the tie of its county units to the Department of Agriculture gave it an unfair and improper advantage. To a lesser extent, membership and business competitors also joined the pro-separation group at different times.

A hypothesis that a formal arrangement under attack would receive aid from those interested in a more general arrangement to which the former was related was answered by a qualified no. Efforts to divorce the farm bureaus from the Extension Service brought into the defending group relatively few who were interested in the broader educational objectives of Extension. The farm bureau-Extension Service agreements were defended most consistently by Extension officials in the formal relationship states, where the educational agency and the farm organization were mutually benefitted by these arrangements. Extension officials in the South, where personnel of that agency had built up the Farm Bureau through the Triple A program, also gave major support. Except for the three states where they helped to secure separation, other state Extension officials were neutral in this controversy.

Most supporters of Extension work eventually backed separation, as a means of cutting the public agency from its embarrassing tie. Officials of the Federal Extension Service and the Association of Land-Grant Colleges and Universities came to adopt this view. Finally, Secretary of Agriculture Benson, with an expanding Extension program in prospect, ordered separation as a means of making the educational agency more effective.

That organizations, even though apparently unified about an issue, are not monolithic, and that effective groups include members from organizations which are officially ranged with the opposition, was demonstrated. With one exception, however, such members of an organization gave relatively little help to the opposition.

Finally, this study demonstrated that parties to this controversy were differentially effective in different parts of the system, and most consistently attempted to influence the element where their strength was greatest. The pro-separation group, smaller in numbers, was most successful in winning over those who were interested in the educational objectives of the Extension program, and key members of the House of Representatives who opposed the Farm Bureau on its farm policy proposals. Its legislative success in the states was always dependent upon consent of the farm bureaus. This was sometimes granted in an effort to diminish public criticism. To win over the opposition so that it would act to halt these public attacks was the most successful approach of the pro-separation group.

321 pages. \$4.15. Mic 56-2713

THE INTRODUCTION OF REPRESENTATIVE INSTITUTIONS INTO MALAYA

(Publication No. 17,530)

William K. Braun, Ph.D.
University of Cincinnati, 1956

Although Malaya has made progress toward independence and the introduction of representative government, the nature of Malayan society raises serious questions as to its ability to support the latter when the influence of the British government is removed. Chief among the problems, which include low literacy level, an inadequately educated mass, and inexperience with the operation of representative institutions, is the existence of historic differences among the various communities which leave Malayan

society with a serious lack of national unity. Except for a very recent political alliance of the communal parties representing the various races, there has been no evidence of a willingness on the part of the Malays, Chinese, and Indians to cooperate in favor of a national interest.

The experiences of countries like India, Burma and Ceylon with independence and representative government cannot as yet be used to evaluate conclusively the ability of backward societies successfully to govern themselves through elected leaders. Continued support by the masses of leaders and parties associated with the struggle against colonialism is no indication that the voters in the future can cope with the demands of representative government. Nevertheless, the nature of the nationalist movements in these countries has done much to provide stable and effective leadership during the very important early period of independence and to encourage the continued growth of a national interest.

Malaya thus far has failed to develop a comparable nationalist movement. The present Alliance Party, the obvious alternative government to the British, is a weak coalition of communal parties designed to bring pressure to bear on Britain for early independence. Serious disagreements over policy have been buried temporarily but must be faced when the responsibility for governing is theirs. A return to separate communal parties at that time would be disastrous to national unity. The British government, in Malaya's own interest, should force the Alliance Party to consider these controversial subjects while the restraining force of British power is still in evidence in order to test the extent to which real effort will be made to compromise racial antagonisms in favor of a national interest. The Alliance victory in the first Federal elections, held in July of 1955, presents the opportunity.

As for suggested forms and techniques of representative government, none of these has much hope of success under conditions of extreme communalism. Therefore, the test to be applied is not as to which will better withstand communalism, but rather which might better work to lessen the danger of a reappearance of purely communal parties. For this reason, the present single district method of electing representatives should be preferred over either communal or proportional representation. Another aid in the encouragement of parties with wider appeal is the provision for a single nationally elected executive. The need to win such an important office should encourage compromise of racial interests to a greater extent than by means of an executive chosen from the legislature.

In the interest of providing leadership by a national party and because federalism is rapidly losing its meaning in Malaya, a unitary system of government should be preferred. Also, to reduce conflict between local, or interest, groups and the more national viewpoint of the governing party, a unicameral legislature should have advantages. Some of the virtues of an upper chamber might be found in an appointed and strictly advisory chamber which could be constructed along interest lines without destroying the responsibility of the government to synthesize conflicting social views.

241 pages. \$3.15. Mic 56-2714

AN APPRAISAL OF THE FISCAL AUTONOMY OF
ST. LOUIS, A HOME RULE CITY: THE ST. LOUIS
EARNINGS TAX, A CASE STUDY

(Publication No. 17,196)

Donald Charles Munding, Ph.D.
Washington University, 1956

Chairman: Carl McCandless

This study was undertaken in an attempt to examine the degree of fiscal autonomy which the city of St. Louis, a constitutional home rule city, enjoys under its constitutional grant. The efforts of this city to assume control over its local finances, by levying an earnings tax, served as the specific case study to test the hypothesis that the Missouri constitutional grant of home rule to St. Louis gave freedom to the city from legislative control over its local finances.

The research techniques employed were primarily historical. This involved reference to committee reports, constitutional convention records, legislative journals, legal case books, newspapers, and the office files of governmental officials. The interview was a second valuable technique. Important government officials, civic leaders, businessmen and other people interested in the city's activities to acquire a permanent earnings tax were interviewed. Statistical analysis, especially in its comparative application to the financial situation of other large municipal corporations, was utilized to determine the need and desirability of the earnings tax.

The scope of this study was confined to the constitutional home rule city of St. Louis. The emphasis was on the financial conditions and crises of St. Louis and its attempts to help itself within the framework of the home rule grant by assessing an earnings tax. The financial analysis that determined the need for additional revenue and the legal analysis which determined the source of authority for the imposition of the earnings tax were of critical importance. The analysis of the efforts of St. Louis to acquire the permanent earnings tax also demonstrated, in a practical way, the results of an ambiguous constitutional home rule grant.

The significant conclusion of this study is that the present St. Louis earnings tax is at the sufferance of the state legislature. The General Assembly specifically offered such authority to the city in Senate Bill No. 3, and this same legislative act controls the operation of significant portions of the earnings tax, including the maximum tax rate which may be levied. In relating the findings of this case study to the hypothesis, the conclusion was reached that the constitutional grant of home rule did not convey complete fiscal autonomy to the city of St. Louis. Suggested areas of further research and study were cited.

359 pages. \$4.60. Mic 56-2715

THE SECOND CLASS TOWNSHIP IN PENNSYLVANIA

(Publication No. 17,256)

Garfield Sieber Pancoast, Ph.D.
University of Pennsylvania, 1956

Supervisor: Jewell Cass Phillips

This study is an analysis and appraisal of the Second Class Township in Pennsylvania. Lowest in the scale of corporate existence, this unit performs general government functions in the least developed areas of the state. Historically, its chief function was the construction and maintenance of roads, and so it continues for most of the townships today. However, population and technological advances have created urban problems for many of the townships in metropolitan areas.

The need for additional authority has been recognized by a sympathetic legislature. Local governments in Pennsylvania are controlled by general legislation for each of the respective local government classes. Subject to constitutional restrictions, legislative control is plenary. Townships may become First Class Townships if they have a minimum population density of 300 persons per square mile but such change in status is not compulsory. Townships enjoy corporate powers and specific grants but are recognized in law as quasi corporations. Three elected supervisors are primarily responsible for township affairs but most townships elect a total of eleven officials.

Questionnaire replies from a selected sample of 130 townships indicated an average performance of six functions--road maintenance by districts, financial support of volunteer fire companies, street lighting in village settlements, civil defense organization, prohibition of garbage accumulation, and a police force of one full-time officer. Most townships have neither justified the conferring of substantial powers upon them nor have they demonstrated their capacity to use their granted powers in the best interests of the community.

Satisfactory methods of financial management have been imposed on the townships, but they are inadequately supervised by the state. More than one-half of township revenues are derived from taxation, one-quarter from grants, and the remainder from miscellaneous sources. Townships could financially support themselves to a greater extent than at present by increased real estate taxes and more extensive use of Act 481 authorizations. Two-thirds of township expenditures are for road purposes, one-tenth for protection, and almost 8 per cent for general government. The high proportion for general government costs is a result of small governmental units employing a large number of part-time officials. Township indebtedness amounted to less than two dollars per capita in 1953.

Does the township measure up to the minimum essentials of a satisfactory unit of government? It is too small in area and lacks sufficient road mileage to constitute an adequate highway unit. It is too small in population and lacks the taxable resources necessary to support essential functions. Its expenditures are not large enough to support an efficient administrative organization or even an adequate highway unit. It enjoys little, if any, real local self-government.

Recommendations to improve the adequacy of the township are the following:

1. Number should be reduced through consolidation and annexation from 1500 to no more than 500.
2. Every unit should have a minimum population of 2000, assessed taxable valuation of \$1,500,000, a total road value of at least 90 wherein bituminous-surfaced road is equated at six times the value of stabilized or unimproved roads.
3. Township classification should be revised.
4. Only policy-determining officers should be elected and administrative authority should be concentrated in one officer such as township manager.
5. Single responsible road superintendent with proved technical competence should head the highway unit.
6. Fiscal year should be July 1 to June 30.
7. Allocation of state aid for highways should be based equally on population and mileage.
8. State supervision through administrative procedures should be improved.

If Pennsylvania is to meet its obligation in strengthening the American federal system, it must take a forthright stand in making the Second Class Township an effective unit of government. 404 pages. \$5.15. Mic 56-2716

THE BACKGROUND OF PRIVATE RIGHTS AND AMERICAN CONSTITUTIONAL DEVELOPMENT

(Publication No. 17,537)

Harold J. Spaeth, Ph.D.
University of Cincinnati, 1956

The dissertation is a study of the theories of private rights which have had currency in the course of American constitutional development. The aspects of these theories which have been particularly considered are: 1) the type of liberty to which emphasis was given -- i.e., whether social and economic or civil liberties; 2) the bases from which these theories developed -- i.e., the political philosophy and formative conditions.

By way of introduction, the origins and pre-Christian development of the concept of a rule of law are traced, as are the medieval principles which pertained to the limitation of government, and the growth of English governmental institutions between the twelfth and fifteenth centuries. Because of their relationship to American developments, the theories of private rights which evolved in England during the constitutional conflicts of the sixteenth and seventeenth centuries are also traced.

The study indicates that theories of private rights have run no even course. By and large, the history of private rights has been a struggle between an established theory and the theory of those seeking governmental recognition. The individuals associated with the various theories sought to make especially private either social and economic matters or civil liberties. The extent of these liberties shows great variance from one age to another, as does the number of persons to whom they are applicable.

The basis from which theories of private rights have

developed is that of the dominant political philosophies of the age. The theories fall roughly into two categories. The first is characterized by an uncompromising postulation of certain areas of human activity outside governmental concern, while the second permits a substantial measure of determination and control of private rights by the political branches of government. Within each category are to be found theories emphasizing socio-economic activities as well as others emphasizing civil liberties.

The study also revealed the ability of natural law to serve as a basis for conflicting theories; both the Revolutionary democrats and the Federalists, for example, based their theories of private rights upon natural law. Also apparent was the tendency of the group in control of or most influential in political matters to use concepts of private rights to support or strengthen its position, particularly where social and economic rights were concerned. The medieval clergy, the English landed gentry in the seventeenth and eighteenth centuries, and, in America, the vested rights' groups of the early nineteenth century and the laissez-fairists of the late nineteenth and early twentieth centuries may be cited in illustration.

To be more specific than the foregoing is to tread upon shifting sands. Private rights are the basis of any system of limited government. But changes in the constitutional system have been attended by variations in the area of private rights, the persons to whom private rights apply, how private rights are determined, and under what circumstances they are held. 413 pages. \$5.30. Mic 56-2717

POLITICAL SCIENCE, INTERNATIONAL LAW AND RELATIONS

THE UNITED NATIONS AND THE LIMITATION OF OPIUM PRODUCTION

(Publication No. 18,273)

Robert Whitcomb Gregg, Ph.D.
Cornell University, 1956

Chairman: Herbert W. Briggs

The international community has taken an active interest in the problem of drug addiction and illicit narcotics traffic throughout most of the 20th century, but it has been extremely reticent about taking the most basic step toward the abolition of those reprehensible practices, i.e., the limitation of opium production to the amount needed to satisfy carefully circumscribed medical and scientific requirements. During the decade since the United Nations was established, the Commission on Narcotic Drugs of the Economic and Social Council has made a major effort to remedy this fundamental deficiency in international treaty law. Its working premise has been that addiction and illicit trafficking will continue as long as a surplus of the principal drug raw material, opium, exists.

The Commission undertook to draft a comprehensive narcotics instrument which would supersede all earlier conventions, protocols, and agreements, and which would also include a program of production control and limita-

tion. It recognized, however, that the problem of over-production is sufficiently urgent to warrant the adoption of interim measures while the so-called "Single Convention" is in preparation. This study analyzes the quest for interim measures which would at once limit the production of opium and receive the widespread support of the nations principally concerned with the opium trade.

Two plans were considered by the Commission. The more ambitious but less acceptable plan would have reduced the production of opium and subjected it to stringent controls by creating an international opium trading monopoly and dividing the export market among producing states according to fixed quotas. In principle, many states were willing to secure the desired objective by drastically curtailing free trade in this commodity; in practice, few were willing to do so. Rejecting the monopoly scheme, the Commission turned to a Protocol which sought to reduce production indirectly by limiting the size of opium stocks which nations might hold. This Protocol, which proposed fewer changes in the status quo, was adopted by the United Nations Opium Conference in June 1953.

This study is based primarily upon documents of the Commission on Narcotic Drugs and of the United Nations Opium Conference. They reveal a decade of unflagging effort but frequent frustration in the quest for a limitation of opium production to the level of legitimate demand. There is still no adequate treaty obligation on this subject; the Protocol has not entered into force, and its effectiveness, if and when it does enter into force, is problematical. Nevertheless, the most serious of all narcotics problems does bear the imprint of an intensive corrective campaign by the United Nations. It is the purpose of this study to review that campaign and offer a few tentative conclusions as to its effect upon the opium production problem.

388 pages. \$4.95. Mic 56-2718

THE MARSHALL PLAN: DECLARED OBJECTIVES AND APPARENT RESULTS

(Publication No. 17,481)

DeVere Edwin Pentony, Ph.D.
State University of Iowa, 1956

Chairman: Professor Vernon Van Dyke

With the passage of the Economic Cooperation Act of 1948 the United States embarked on a very extensive program of foreign economic aid which was to be channeled, for the most part, to Western Europe. The first part of this study contains an analysis of the objectives of the program as enunciated by Congress, the Administration and the interested public. It is maintained that the program was adopted primarily as a measure to protect and promote the vital self-interests of the United States although no attempt is made to deny that idealistic-humanitarian motives played their part in causing the United States to embark on such a tremendous venture. Further, the contention is that there was general agreement among the supporters of the Marshall Plan that the rehabilitation of Western Europe was considered necessary to the security and well-being of the United States in a world confronted by the imperialistic tendencies of the Soviet Union. How-

ever, security in this sense meant more than military security. It meant that the United States was interested in promoting positions of political and economic strength in Western Europe in hopes not only that the military security of the United States would be enhanced by gaining powerful allies, but also that the American economy would be more secure if this highly important segment of the world economy were stabilized. Moreover, there was a very definite feeling that Western Civilization (of which the United States was definitely a part) with its democratic institutions was none too secure when Western Europe appeared to be on the brink of disaster economically and politically. The threat of communism seemed ever in the minds of those who supported the Marshall Plan and, as a consequence, they believed that the security, indeed the very existence, of those cherished institutions and ways of living was in great danger.

The second part of the dissertation contains a brief explanation of the system which the United States, in cooperation with the European recipients of the aid, utilized in the effort to restore the economy of Western Europe to health. The dollar-deficit principle is explained and analyzed and the loan and counterpart fund devices are discussed.

The final portion of the study includes an analysis of the results of the program as indicated by the improvement in the various European economies some three years after the inauguration of the plan. There can be little doubt that the program was an outstanding success in helping a floundering Europe to its feet. The beginning of the year 1951 witnessed a near phenomenal recovery in most areas of the Western European industrial economy. Productivity was up in the majority of the basic industries, the financial situation was more stable, and the international trading position of Western European countries was markedly improved over 1947-48. Although Western European agriculture had not made as significant a recovery, it too was much improved over the dark days of the early post-war years. Western Europe, as a consequence, might well prove a valuable ally to the United States, able to resist the encroaching arm of the Soviet Union and able to forestall communist success domestically. In addition, the Marshall Plan to some extent is encouraging Western European integration.

It is also maintained that the American economy was benefited by the plan although the results are not as clear-cut here, primarily because the period analyzed was too short to determine long-run benefits. Western Civilization, too, seemed more able to withstand the threatening pressures as the Marshall Plan period ended. Finally it is argued that the expectations of those who supported the program were largely fulfilled and that the United States was in a more secure position generally as the result of having carried out the program.

357 pages. \$4.60. Mic 56-2719

PSYCHOLOGY

PSYCHOLOGY, GENERAL

THE PREDICTION OF POTENTIALS FOR EFFECTIVENESS IN CERTAIN OCCUPATIONS WITHIN THE SALES FIELD

(Publication No. 16,609)

Arthur Aaron Witkin, Ph.D.
New York University, 1956

This study is an investigation of differentiating factors among three groups of salesmen, namely, specialty salesmen, route salesmen, and sales engineers. The research population was 300 successful salesmen drawn from 22 different companies in the United States and Canada, and divided evenly among the three sales occupations involved. The study deals with a problem that is of importance to guidance counselors in schools and colleges and also to those concerned with the selection of salesmen in the business world.

The study has its basis in the research that has been done in the selection of salesmen. The history of such research is traced in order to show that tests of the type used in the study have been effective in differentiating successful salesmen from unsuccessful ones.

The data used were collected through a management consulting firm which tests salesmen for many different business concerns. The data involved scores on the Otis Self-Administering Test of Mental Ability, the Personality Inventory by Robert G. Bernreuter, and on the following nine scales of the Strong Vocational Interest Blank: sales manager, real estate salesman, life insurance salesman, production manager, personnel, accountant, office worker, purchasing agent, and advertising man.

The criterion of success utilized was the appraisal of the sales manager. The managers were asked this question: "Would you rehire this man if he were a new applicant and you knew as much about him as you now do?"

The major statistical approach was an analysis of variance to determine differences among the three groups. In addition, the extent to which each group differed from some general population standard was investigated.

Conclusions

1. With respect to performance on the Strong Vocational Interest Blank, specific differentiating characteristics among the three sales groups were revealed for seven of the interest scales. At the one per cent level of significance, differences were found on the scales for production manager, accountant, office worker, purchasing agent, real estate salesman and life insurance salesman. At the five per cent level, differences were found on the personnel scale. No significant differences among the three groups were found on the advertising man scale.

2. With respect to the Bernreuter Personality Inventory, no significant differences among the three groups were found in this study. The groups do differ significantly from the general population on all scales of the Bernreuter Test except for specialty salesmen and the route salesmen

on the B2-S or self-sufficiency scale. The differences found indicate that salesmen are more emotionally stable, less introverted, more dominant, more self-confident and more sociable than the general population.

3. With respect to the Otis Self-Administering Test of Mental Ability, the sales engineers were found to be significantly higher than either the route salesmen or specialty salesmen.

4. The study supports the trend to focus on specific occupations within the sales field rather than to consider selling as a unified occupation without subdivision.

Suggested Applications

This study has applications for vocational counselors in guiding individuals in their selection of a type of sales position. It should also be of value to business concerns and industrial psychologists in selecting salesmen whose jobs fit into one of the three categories of this study.

149 pages. \$1.86. Mic 56-2720

PSYCHOLOGY, CLINICAL

A COMPARISON OF THE DISTRACTIBILITY OF INTELLECTUALLY NORMAL AND MENTALLY RETARDED SUBJECTS

(Publication No. 18,140)

Beverly Golden, Ph.D.
University of Illinois, 1956

Clinical observation, educational experience, certain infrahuman studies, and an interaction theory of cerebral dynamics concur in suggesting that exogenous mental deficiency will be manifest in heightened, indiscriminate, and disruptive responsiveness to extraneous stimulation (i.e., pathological distractibility). The purpose of this investigation was to determine the diagnostic utility of experimental situations designed to provide an objective and quantitative measure of the degree, kind, and effect of responsiveness to extraneous stimulation.

Four groups of 19 Ss each, matched by Revised Stanford-Binet Intelligence Test MA were employed. The MA range for Ss was 4-0 to 6-8. There was a group of intellectually normal Ss and three groups of mentally retarded Ss, endogenous mental defectives and trained and untrained exogenous mental defectives. The ESRT entailed the measurement of the retention of a random sample of extraneous stimuli which were spatially contiguous with the administration of a series of modified "Binet-tasks." A relative measure of distractibility was obtained which was indicative of the proportion of total behavior tapped in the situation which was attributable to responsiveness to extraneous stimuli. The "surplus" learning test involved the measurement of the responsiveness to extraneous stimulation in the context of a modified "incidental" learning situation. In the latter situation an absolute measure of distractibility was obtained.

The performance on the ESRT of untrained exogenous mental defectives and normal Ss was analyzed by either t tests for matched Ss or Signed Rank Test for Paired Observations. The same statistical tests were employed for the comparison of the untrained exogenous mental defectives and the endogenous group. These several tests led to the conclusion that there was a tendency which approached significance for untrained exogenous mental defectives to manifest a larger proportion of total behavior attributable to responsiveness to extraneous stimulation. It was proposed that the groups tend to differ in the "efficiency" of their total behavior exhibited in a testing situation.

Comparison of two sub-scores based upon retention of extraneous stimuli of different physical distance from "Binet-tasks" by Signed Rank Test for Paired Observations indicated that all groups respond more to physically proximal than physically distal extraneous stimuli. Hence, there is significant negative evidence for the proposition that, exogenous mental defectives respond indiscriminately to extraneous stimuli.

Product-moment correlations of scores on "Binet-tasks" and the total number of extraneous stimuli recalled were insignificant for all groups. A model of Hebb proposing the autonomy of central on-going activities and peripheral sensory events seems tenable, and there is no basis for inferring that responsiveness to extraneous stimuli is disruptive (alters performance on focal activities) in exogenous mental deficiency.

Analysis of variance for matched Ss indicated that the normal, endogenous mental defective and untrained exogenous groups differed significantly in "surplus" learning. Comparison by t test for matched Ss of normal and untrained exogenous defective groups revealed a tendency for the exogenous group to exhibit greater "surplus" learning than normal Ss. The endogenous mental defective Ss showed significantly greater "surplus" learning than the other groups. This finding represents significant negative evidence for the fundamental tenet of this investigation: exogenous mental defectives will exhibit the greatest responsiveness to extraneous stimulation. The generality of the ESRT and "surplus" learning situation is a function of the groups; for exogenous mental defectives a similar function is tapped.

In general, the present investigation indicated that the experimental situations were not suitable for the differentiation of exogenous mental defectives from intellectually normal subjects or endogenous mental defectives.

94 pages. \$1.50. Mic 56-2721

EXPERIMENTAL REPRESSION RELATED TO COPING AND AVOIDANCE BEHAVIORS IN THE RECALL AND RELEARNING OF NONSENSE SYLLABLES

(Publication No. 17,135)

Willard Alwin Mainord, Ph.D.
University of Washington, 1956

This study is concerned with repression, operationally defined, and with the selection of subjects most and least likely to exhibit it. Repression is defined as a deficit in recall associated with affective as opposed to neutral stimuli. Affective stimuli are defined as words associated

with experimentally determined failure experiences, and, also, words selected from word-association tests which elicit disturbances theoretically produced by affective arousal. Neutral stimuli are defined as those words in a word-association test which elicit no signs of affective arousal.

Selection of subjects is based upon a sentence-completion test scored in terms of evasiveness or directness of the responses to the sentence stems. Those who respond directly are called copers; those who respond evasively are called avoiders. Drawing upon the work of Freud and the learning theorists, it is possible to predict that only the avoiders will exhibit experimental repression.

After selection of the subjects, it is necessary to create failure words, to select traumatic and neutral words, to control learning, and then to test for recall and relearning. In order to do this, it becomes necessary to investigate the role of "response entropy" in the experimental task. Response entropy is a concept advanced by Laffal to account for disturbances upon word-association tests without postulating emotional factors. It can be defined as the degree to which a stimulus word elicits a common response within a given group. Words that elicit many responses have high entropy values, and words that elicit few responses have low entropy values. In order to control learning, nonsense syllables are assigned to be learned to the stimulus word. In order to control for entropy, a separate subsidiary experiment was completed that indicated that response entropy was not a relevant variable in the recall of nonsense syllables associated with stimulus words.

Failure words were created by using words in the titles of simulated tests of abilities which were made impossible of completion by the experimenter. Individually selected words from word-association tests provided the neutral and the traumatic words. The subjects, all female advanced student nurses, were required to learn three lists of nonsense syllables in association with their own unique traumatic and neutral words, and with a more common set of failure words.

As experimental control was not attained in the creation of the failure words, conclusions can be drawn only from the stimuli selected from the word-association tests.

The conclusions are: (1) Avoiders will show experimental repression, whereas copers will show an opposite effect called "sensitization." (2) It is possible to select by means of a sentence completion test copers and avoiders who will or will not exhibit experimental repression depending upon which category they resemble. (3) Response entropy is not a variable in the recall of nonsense syllables associated with stimulus words.

Empirically, it is shown that the Heterosexuality Subscale of Edward's Personality Preference Schedule will reliably differentiate copers from avoiders. Other variables are examined with no conclusive results.

117 pages. \$1.50. Mic 56-2722

DIFFERENTIAL SUCCESS OF NEUROPSYCHIATRIC PATIENTS IN PREDICTING THE SELF-RATINGS OF OTHER PERSONS

(Publication No. 17,556)

Edward Francis O'Day, Jr., Ph.D.
The University of Florida, 1956

This study consisted of an initial investigation of some theoretical formulations induced from subjective observations of both normal and maladjusted persons with respect to their relative abilities to understand other people. The basic theory underlying the study is that a person's molar adaptation to psychological distress is related to his ability to understand others. More generally, the theory may be summarized as follows:

Unresolved psychological conflicts give rise to psychological distress, which an individual may either tolerate and experience directly, or avoid through various defensive measures. If the individual is unable to resolve his conflicts and does not use drastic defenses against the experience of distress, the experience acts to sensitize him to those aspects of his environment which tend to intensify the distress. Since most serious psychological conflicts have their implications on interpersonal relationships, the person is sensitized to many of the actions and attitudes of others. Being more sensitized, he is more aware of others, and understands them better than a more comfortably adjusted person. If, however, the person is unable to resolve his conflicts, but defends against the experience of distress in a nonadaptive fashion, his ability to understand others is less than that of normals, since (a) he is no longer as acutely distressed or sensitized, and (b) the mechanism by which relief was gained may make his perception of others less accurate. Of course, the many defensive mechanisms available differ in the degree to which they impair accurate perception of others.

The dependent variable, the psychological phenomenon of understanding others, was measured by having the subjects predict the self-rating of a standard unfamiliar person. Normal subjects and subjects from five neuropsychiatric diagnostic classifications were studied. Deductions were made from the theoretical formulations regarding the relative abilities of the subjects from each of the six groups to understand other people. A hypothesis was derived from these deductions; it stated that the measurements of the dependent variable for the six groups would be ordered as follows:

- (1) Neurotics
- (2) Normals
- (3) Character Disorders
- (4) Alcoholics
- (5) Paranoid Schizophrenics
- (6) General Schizophrenics

The observed ordering of the groups on the dependent variable was as follows:

- (1) Character Disorders
- (2) Neurotics
- (3) Normals
- (4) Alcoholics
- (5) Paranoid Schizophrenics
- (6) General Schizophrenics

A nonparametric statistical test revealed that the prob-

ability was less than .03 that the observed ordering would conform to the predicted ordering as closely as it did, if the population from which the samples were drawn were not ordered as predicted. Thus, the theoretical formulations, as tested, were sustained. It was found, however, that the dependent variable, the psychological phenomenon of understanding others, contained component aspects which became obvious under additional statistical treatments. Therefore, a distinction was made between (a) the net manifest understanding which was measured operationally in the experiment, and with which the fundamental hypothesis was sustained, and (b) other factors which influenced the net manifest understanding. One factor, which was inferred from the findings, was a predisposition on the part of the subjects to predict the self-ratings of unfamiliar persons in conformity with an idealized stereotype. The implications of this propensity and other factors on the theoretical basis of the study were discussed; and various modifications in the experimental design were suggested in order that future research may reveal more about the effects, influences, and interrelationships of the various factors making up the net manifest understanding.

148 pages. \$1.95. Mic 56-2723

CLUSTERING OF VERBAL ASSOCIATES IN SCHIZOPHRENIA AND CHRONIC BRAIN SYNDROME

(Publication No. 18,335)

Sidney Arthur Orgel, Ph.D.
The University of Connecticut, 1956

The present study was designed to investigate how deviant groups behave when presented with a task in which S is asked to recall randomly presented verbal associates. The recall, organization or clustering, and errors of these associates were studied. The aim was to determine whether pathological groups differ from controls in clustering and whether they differ from one another.

Subjects consisted of 120 males divided into four groups of 30 each. A control group was composed of Ss gainfully employed, and "neuropsychiatrically clear", i.e., not known to be eccentric. A second and third group of paranoid schizophrenic and hebephrenic schizophrenic Ss were selected on the basis of a behavioral diagnostic scheme devised to yield demonstrable inter-rater reliability. The fourth group was composed of chronic brain syndrome epileptics (idiopathic) presenting clear-cut diagnoses. The four groups were equated on the variables of age, years of schooling, months of hospitalization, and Stanford-Binet Vocabulary IQs. The overall selection of the hospitalized groups employed a modified stratified quota method of sampling.

The clustering material was presented to the subjects visually, employing a modified memory drum apparatus, and consisted of a 40 word list of nouns, 10 words in each of four categories. All words were equated by means of the Thorndike-Lorge word list for their frequencies-of-usage. The hypotheses of this study, derived from Hebbian theory, clinical literature and prior clustering research, may be summarized as follows: There will be significant differences in the clustering task among the four groups both for degree of organization and for amount of recall.

They will order themselves from most to least amount of clustering as follows: controls, paranoids, hebephrenics and epileptics.

Even with memory controlled, there will be significant differences in clustering among the four groups. The ordering hypothesized remains identical.

Regardless of nosological group, a positive relationship is predicted between amount of recall and general clustering level.

Significant differences will occur in the amount and kinds of errors which the various groups introduce into their clustering of the material.

Significant differences in the rate of production of items is predicted, the same ordering again being hypothesized.

From an analysis of the results, the following conclusions were drawn:

In terms of the conventional treatment of the clustering task, the three nosological groups differ significantly from the controls. The hypothesized order for amount of clustering is substantiated.

The obtained difference among the groups is a function of a complex of factors. For the paranoid group, their decrement is one of a deficit of recall. Although recall is reduced for both the epileptic and hebephrenic groups as well, when the effect of this lowered recall is removed by covariance, the decrement experienced by the epileptics is demonstrated to be a function of both reduced recall and their confabulatory activity.

For the hebephrenic group, their decrement on the task is due not only to reduced recall and much confabulation but also to a true deficit in organization.

The degree of relationship between clustering and recall differs for the various groups.

The groups differ significantly in the number of irrelevant intrusions produced, but do not differ in the number of categorical intrusions produced.

Differences obtained among the groups in their rate of production of items as measured by two half-life indices.

In the light of previous research findings and the clinical literature the data warrant emphasizing the distance that apparently exists between the hebephrenic and paranoid schizophrenic subgroups. Furthermore, the data tentatively lead to the surmise that no true organizational deficit occurs among psychotic epileptics. Areas for further research growing directly out of the clustering data and also out of the general implications concerning the deficit in organizational processes of pathological groups are drawn.

129 pages. \$1.75. Mic 56-2724

THE INFLUENCE OF AFFECTIVE STATES UPON THE BODY-IMAGE AND UPON THE PERCEPTUAL ORGANIZATION OF EXTERNAL SPACE

(Publication No. 18,088)

Bernard Philip Rosenblatt, Ph.D.
Clark University, 1956

Supervisor: Theodore Leventhal

The general purpose of the present study is to investigate certain aspects of affective states as they relate to

the body-image and to the perceptual organization of external space. The affective states which are dealt with are those of elation and depression. For this purpose, three groups (manic, depressed, normal) were selected.

The methods used to study differences between the groups in body-image and in perception of space were respectively drawing techniques and perceptual techniques.

A central assumption of the study is that upward and downward vectors are integral characteristics of elated and depressed organismic states, an upward vector characterizing elation, a downward vector characterizing depression.

A further basic assumption of this study is that these vectors, as aspects of the organismic state pertinent here, are factors involved in the formation of the body-image; but that they are also relevant variables in regard to the perceptual organization of external space. The specific experimental methods used have emerged from these assumptions. Accordingly, the groups were compared with respect to differences in certain indicators of perception (space localization) and certain indicators which are assumed to reflect the body-image (drawings of the self, others, objects, etc.)

Four main methods were used. Three methods involved drawings: life-size human figure drawing, small-size drawing of a person, and drawings of geometric figures. In addition, changes in perceptual organization were studied in terms of shifts of the position of the apparent horizon.

Two general hypotheses were formulated:

Hypothesis Concerning Body-Image Methods: the location and extension properties of the drawings, insofar as they reflect body-image, will vary in an upward or downward direction, depending on the affective state.

Hypothesis Concerning Spatial Organization: the perceptual organization of external space in terms of the physical position of the horizon will vary in an upward or downward direction, depending upon the affective state.

The two general hypotheses are supported by the findings. Some specific results may be mentioned. The main findings of the experiments using life-size drawings of the human figure concerns the location of the uppermost point of the drawing, in relation to the top of the subject's head: this point, for the manics, was located significantly higher than for the normals or the depressed. Small-size drawings of a person show that the height of the figure, in relation to the bottom of the page, is significantly greater for the manics than for the depressed. Also the length of the figure is greater for the manics than for the depressed.

The main results concerning space perception are as follows: the physical position of the apparent horizon is located significantly higher for the manics than the depressed, with the normals falling between. These differences are statistically significant.

The findings were discussed in general terms: viz. in terms of the influence of the vectorial aspects (in the up-down dimension) of affective states upon the internal organization of the body-image on the one hand, and, on the other hand, upon the perceptual organization of external space. Specifically, the results concerning shifts in the physical position of the apparent horizon are discussed within the framework of sensory-tonic theory.

98 pages. \$1.50. Mic 56-2725

AN EXPERIMENTAL INVESTIGATION OF
THE EFFECT PRODUCED BY
CALLING ATTENTION TO STUTTERING

(Publication No. 17,152)

Marcel Edward Wingate, Ph.D.
University of Washington, 1956

The phenomenon of stuttering has drawn interest for centuries and many explanations have been offered to account for it. However, it has only been within relatively recent times -- actually the past three decades -- that it has received much concentrated attention. One of the most influential points of view that has developed in this period has been the "semantogenic" or "evaluational" theory of Wendell Johnson which asserts that stuttering develops as a result of parental disapproval of "normal non-fluency" in the early stages of speech development and persists because the individual strives to avoid the non-fluency which was disapproved. This theoretical viewpoint cautions heavily against calling attention to stuttering, the notion being that this has the effect of increasing the attempt to avoid non-fluency, i.e., increases the stuttering. This injunction against calling attention to stuttering has received widespread acceptance although support for such acceptance has been largely on a "common sense" basis with only implicit support from a few experimental studies. This notion has not been adequately explored, apparently because it has been accepted quite uncritically.

The present study presents a challenge to this position by devising a test of the following hypothesis: that stutterers will not stutter more but rather will stutter less under conditions in which they are made aware of their stuttering. This hypothesis was tested by measuring the speech performance of individual stutterers in three different conditions in which they spoke a set of simple directions to another person who followed the commands. In one condition the subject was permitted to speak in his normal manner; in the other two conditions attention was called to his stuttering -- in one by interrupting the stutterer when he began to stutter, and in the other by reminding him that he had stuttered immediately after he had done so. The results obtained show that the subjects stuttered significantly less in the two experimental conditions. Analysis of the results indicates the interpretation that this decreased frequency of stuttering was due to the subjects' assuming a set not to stutter, that is, a set to avoid speaking non-fluently.

The discussion stresses that the widespread acceptance of the notion that stuttering is "avoidant" behavior has obscured our vision of several important features about stuttering. Disapproval, and the stutterer's reaction to his speech are accepted as factors that play a role, but not the most prominent ones. An outline of a new way of looking at the development and persistence of stuttering is offered. The suggestion is made that a different direction is called for in our thinking about the stutterer's motivation -- one that will take into account the economy of stuttering in the total process of communicating and relating to another person.

It is felt that the results of the study hold implications for the recent attempts to describe stuttering as a form of instrumental learning. Many of the criticisms leveled at Johnson's conception can also be raised against the view that stuttering can be explained as instrumental avoidance

learning (a view derived from Johnson's position). The instrumental escape learning paradigm appears to be a more satisfactory model, offering several advantages.

60 pages. \$1.50. Mic 56-2726

PSYCHOLOGY, EXPERIMENTAL

ASSOCIATION-PROBABILITY IN THE STUDY
OF VERBAL BEHAVIOR

(Publication No. 17,176)

V. Ralph Buzzotta, Ph.D.
Washington University, 1956

Chairman: Frederick H. Kanfer

It has been suggested that the basic variables in verbal behavior need not be judgmental classifications of verbal units like word meaning and similarity, but rather the conditions influencing the probability that any given stimulus word or words would tend to be followed by a certain response word or words. The present investigation concerned the study of intraverbal connections, i.e., the effects of a prior word in determining the selection of an associated subsequent word presumably reflecting the effects of past learning.

Using verbal material from verbal association sequences, (e.g., Earth - Round - Ball), with known normative dependent probabilities existing between the word units, the present study was carried out to reflect on two problems. The first problem concerned the usefulness in predicting facilitation of learning from knowledge of the normative dependent probabilities along verbal association sequences. In other words, was the probability of occurrence of the third words in such sequences, in part, a function of the normative dependent association probabilities of the second words following the first words? The second problem considered whether this function would hold even though the second words were never used in any overt manner in the experiment proper, so that any effect could be inferred to be "mediated" in some implicit manner due to the already existing intervening language habits.

In a preliminary study a number of associative verbal sequences were empirically obtained through association test norms. Next, three lists of six words sequences composed of three words, A - B - C, were chosen so that the three lists differed systematically in the dependent probabilities associated with the initial part of the word sequence (PB/A). C's were associated by the normative population with equal probabilities to the complex A & B but were associated to A alone less than 1% of the time. These lists of sequences were called high, medium, and low probability sequences. Subsequently, six pairs of unrelated A & C control words were obtained and constituted the unrelated probability sequence. Four Task 1 lists were composed of nonsense syllables paired randomly with the A words of the four probability level sequences. Four Task 2 lists were composed of the same nonsense syllables but paired with the corresponding C words of the four probability levels. Four experimental groups, each com-

posed of 24 Ss, learned one of the Task 1 lists followed by the respective Task 2 list. The four control groups, each composed of 10 Ss, learned one of the Task 2 lists without any prior learning. It was predicted that the ease of learning of Task 2 following Task 1 would vary as a positive function of the dependent probability levels of the B following A words; with no prior learning the ease of learning the lists of Task 2 would not differ.

The probability of B following A words appeared to effect differential facilitation of learning on Task 2 even though the B item was never used in any overt manner in the experimental procedure. It was found that the higher PB/A values yielded significantly greater transfer on the lists of Task 2. It was concluded that the probability of the B following A words could be considered as a measure of an implicit or mediating response hierarchy acting in a contextual manner to increase the probability of obtaining a given associated verbal unit. Means of further exploring this variable and relating it to other conditions affecting verbal association tendencies were suggested.

77 pages. \$1.50. Mic 56-2727

CHOICE BEHAVIOR AS A FUNCTION OF DRIVE STRENGTH AND RATE OF LEARNING

(Publication No. 17,465)

John Warner Davenport, Ph.D.
State University of Iowa, 1956

Chairman: Professor Kenneth W. Spence

In an attempt to study the effect of drive strength and rate of learning on choice behavior induced by differential numbers of trials, 114 albino and hooded rats were given 156 trials each in an elevated spatial discrimination apparatus. Trials were administered in blocks of three, the first being a choice trial and the last two being forced trials. The forced trials were scheduled so that, in each three-trial block, an animal was given two trials to one side and one trial to the other.

Drive strength was varied by depriving Ss of food for 3, 22, or 41 hours. Rate of learning was defined by the rate-of-approach parameter, i , in the exponential function fitted to an animal's forced-trial speed measures.

The results indicated a low degree of discrimination in all groups. Only the 41-hour group showed statistically reliable evidence of a discrimination based on differential numbers of trials. Animals for whom the more frequently reinforced side was on the right tended to behave differently from animals forced more often to the left. In neither case was per cent choice of the more frequently reinforced side clearly an increasing monotonic function of drive strength.

The general flatness of the choice curves made it difficult to judge unambiguously where choice maxima occurred. In the few cases in which significant increases over the 50% level were obtained, there were, in general, only slight suggestions of subsequent decreases. Thus, adequate conditions for investigating the relation between rate of learning and choice behavior were not present.

The choice results were interpreted as offering only slight support for Hull's D x H hypothesis. The general

inconclusiveness of the choice data was considered to be due to the apparent presence of a high degree of generalization between the stimulus complexes to be discriminated and the operation of an extraneous position factor.

75 pages. \$1.50. Mic 56-2728

PROBLEM-SOLVING BY MATURE RATS AS CONDITIONED BY THE LENGTH, AND AGE AT IMPOSITION, OF EARLIER FREE-ENVIRONMENTAL EXPERIENCE

(Publication No. 17,549)

Bernard Eingold, Ph.D.
The University of Florida, 1956

The purpose of the study was to test Hebb's general notion that the earlier rats are exposed to a perceptually enriched environment, the greater will be their problem-solving ability when mature. The specific hypothesis tested was that enhancement of the problem-solving ability of mature rats is a function of the amount of this free-environmental experience and the age at which it is provided. Six experimental and one control group, consisting of fifteen animals each, were used in the study. A split-litter control was exercised. All groups, except the controls, were placed in a large free-environmental area containing playthings for 10 or 20 days at mean ages of 35, 55, or 75 days. The control group was housed in standard laboratory cages fitted with opaque sides; the tops of the cages were always covered with laboratory paper. The experimental groups were also housed in these cages except for the period spent in the free-environmental area. All animals were handled the same number of times during rearing.

Half of each group was tested at 102 days of age and half at 127 days on an adaptation of the Hebb-Williams closed-field test. The results may be summarized as follows:

- Animals tested at 102 days of age did not differ from those tested at 127 days.
- Sex does not influence performance in the test situation.
- Length of exposure did not appear as a significant variable.
- Age at exposure appeared as a significant variable -- the group receiving free-environmental experience at the mean age of 55 days, i.e., Groups III and IV combined, performed significantly better than those receiving it at 35 or 75 days.

The study supports Hebb's theory that wide perceptual experience provided early in life has a beneficial effect on the problem-solving ability of mature rats. It does not support his notion that the enhancement is inversely related to the age at which this experience is received. Unimproved performance by groups provided with this experience at very early ages or at ages close to maturity, was accounted for in terms of relevant or prominent stimuli.

The experimental hypothesis tested was: the effect of free-environmental experience on problem-solving ability of mature rats is a function of the length of this experience and the age at which it is permitted. This predicted that

the age at the time of exposure, the length of exposure, or an interaction of these variables would be significant. The experimental results support the prediction made with respect to the age variable.

66 pages. \$1.50. Mic 56-2729

**A TEST OF PRIMARY STIMULUS
GENERALIZATION BY THE SINGLE-STIMULUS
TRAINING TECHNIQUE**

(Publication No. 17,608)

Melvin Freitag, Ph.D.
University of Virginia, 1956

The present study was designed to test differential predictions arising from the Lashley and Wade and Hull positions on the nature of stimulus generalization. In Exp. I four groups of eight albino rats were given 40, 80, 120, and 160 reinforced single-stimulus trials in a straight runway to a goal box having a black or a white card at its entrance. They were then tested for generalization effects in a modified Lawrence-type apparatus by reinforcing the card not experienced in the single-stimulus training and not reinforcing the formerly positive card. Training was continued until 18 out of 20 correct responses were obtained. The results indicate that the various amounts of single-stimulus training caused no differential effects on the later simultaneous discrimination.

Exp. II was designed to control certain factors that may have contributed to the negative results of the first experiment. Three groups of six albino rats were given 0, 20, and 40 single-stimulus training trials in stepping across a 4-in. air gap into a goal box having either a black or a white card at its entrance. Generalization effects were then tested in a modified Lawrence-type apparatus where a choice of the two cards was necessary. Response to the novel card was now reinforced. Training was continued until 18 out of 20 correct responses were obtained. No statistically significant differences in the number of trials required to learn the simultaneous discrimination were found.

The results of these two experiments seem to provide evidence for the Lashley and Wade position, i.e., an opportunity for comparison is necessary for a discrimination to be developed.

The positive findings of other experiments that have been reported in the literature are interpreted as resulting from the presence of three factors: failure to control secondary reinforcement, the use of unusual techniques for ensuring long exposure to the discriminative stimuli, and short delay of reinforcement.

92 pages. \$1.50. Mic 56-2730

**AN EXPERIMENTAL INVESTIGATION OF
WHITENESS CONSTANCY WITH SUGGESTIONS
FOR AN EXPLANATORY APPROACH**

(Publication No. 17,231)

William O. Hambacher, Ph.D.
University of Pennsylvania, 1956

Supervisor: Professor William A. Shaw

Two whiteness constancy experiments were performed to: (1) test predictions from a traditional theory and (2) test predictions from Wallach's equal brightness ratio theory under conditions of homogeneous backgrounds of the standard and variable discs. In Experiment I, the standard and variable stimuli were composed of Munsell discs on a color wheel, while Experiment II was designed in accordance with procedures reported by Wallach. Eight subjects were used, each taking part in both experiments. Half the subjects participated in Experiment I first and half participated in Experiment II first. In both experiments subjects were given ten trials per day for three consecutive days and were required to match the whiteness of the variable disc to that of the standard by the method of average error.

The prediction from a traditional theory, that subjects would make a brightness match under the condition of homogeneous backgrounds of the standard and variable discs, was not supported.

Predictions from Wallach's theory that subjects would form equal brightness ratios under the conditions of Experiments I and II were also not supported. The obtained results, however, more closely approximated predictions from Wallach's theory than that from a traditional theory.

The results obtained appear to support the hypothesis that subjects, when adjusting the variable disc to equality with the standard, form equal whiteness ratios, i.e., the variable disc is adjusted so that the ratios of the whitenesses of the standard disc to its background and the variable disc to its background are equal. At present this hypothesis is valid only for the condition of homogeneous backgrounds of the standard and variable discs. Further research is planned to investigate the range and types of background heterogeneity for which this formulation is valid.

40 pages. \$1.50. Mic 56-2731

**AUDITORY FLUTTER FUSION AS A MEASURE
OF CENTRAL EFFECTIVENESS**

(Publication No. 18,277)

Lois Carolyn Lawrence, Ph.D.
Cornell University, 1956

The problem of this thesis is to study further the Auditory Flutter Fusion threshold (AFF) and to assess the relationship of change in AFF threshold to the central state of the organism. Central effectiveness is defined as being a central, or core, capacity for productive output, referring to a temporary condition of the organism. To some extent, central effectiveness is inversely related to the familiar construct of fatigue; the less fatigue, the higher the level of central effectiveness.

The AFF method is analogous to visual flicker fusion.

Interrupted white noise, serving as the stimulus, is cut off in square wave form. The frequency of interruption is continuously variable. Sound level intensity is held constant while rate of repetition of noise bursts is increased until the subject reports that he hears the beginning of the fused sound.

Three experiments were completed to test the hypothesis that the AFF threshold changes as a function of change in the level of central effectiveness.

The first experiment was designed to determine whether the method would detect changes in effectiveness occurring during the normal working day of clerical employees. Eleven subjects were tested five times a day for two weeks after an initial training period. Threshold response curves for each S show, generally, a downward trend during the course of each working day, with the threshold rising to its original value the following morning. This experiment suggests that AFF measures a discriminatory ability which decreases as the work day progresses - that is, as one expects level of central effectiveness to decline.

The purpose of the second study was to ascertain whether AFF method could discriminate differences in central effectiveness resulting from differential work loads. Subjects were tested during the course of three weeks; because of the intervention of a national holiday, work loads for one week were heavy, for another week light, and for the third week average. A binomial test was used to test the hypothesis that for each S the mean threshold decrements for the three weeks would fall in the order: (easy week < average week < difficult week) against the null hypothesis that there would be no differences. The null hypothesis was rejected at better than the .05 level of significance.

The third experiment was planned to study the effects of mild drugs (stimulants and depressants) on AFF thresholds. Drugs included caffeine, phenobarbital, dexedrine, serpasil (rauwolfia), and placebo (lactose). The hypothesis was that caffeine should produce a smaller threshold decrement (or even an increase in threshold) than phenobarbital, with the placebo occupying an intermediate position. Dexedrine and serpasil were predicted to produce less change. Twenty subjects participated, each reporting for a training session and for six two-hour experimental sessions. Treatments were assigned by four independent Latin squares. Each subject received every drug, one per session, but in a unique order. When results were analyzed, the hypothesis concerning relative order of drug effects was confirmed at the .001 level of significance. A complete analysis of variance was performed to isolate the contributions to the total variance of the main variables and the major interactions. Results support the hypothesis that AFF measures level of central effectiveness.

Questionnaires designed to measure feeling tone were administered at all test sessions. The final questionnaire shows a small, significant positive correlation with change in AFF thresholds.

In conclusion, there is substantial evidence for the hypothesis that AFF measures change in the level of central effectiveness. The simple technique and easily portable apparatus render AFF important as an auditory phenomenon in its own right and as a means of assessing level of central effectiveness in other situations.

92 pages. \$1.50. Mic 56-2732

INDICES OF VERBAL RESPONSE PROBABILITY

(Publication No. 17,619)

William Allen Lee, Ph.D.
University of Virginia, 1956

The experiment compared four behavioral indices in terms of the sensitivity of each to changes in the response probabilities of nonsense syllables. The indices compared were latency, response frequency, recognition threshold, and resistance to extinction.

The subjects were twenty volunteers, 15 males and 5 females, ranging in age from 19 to 31 years.

The procedure used was designed to produce different response probabilities among the nonsense syllables by means of differential verbal reinforcement. The syllables were presented tachistoscopically and the subject responded with the syllable which he believed had been presented, choosing from a list when he was uncertain. The experimenter said "Right" (reinforcement) or "Wrong" (non-reinforcement), whichever was appropriate. By manipulating the sequence of presentation of the syllables, the experimenter arranged that two of the ten responses were given 50% reinforcement and two others were never reinforced.

The frequency-of-response measure was derived from the data of the last few trials of this procedure. Duration thresholds and latency measurements were obtained for the four differentially-reinforced syllables, and a series of extinction trials was presented to provide measures of resistance to extinction.

It was found that all four indices showed significant differences in the expected direction between the frequently-reinforced and the unreinforced responses. The threshold measure was the most sensitive index of response probability in this situation.

60 pages. \$1.50. Mic 56-2733

VIGILANCE AND CONDITIONED AVOIDANCE ACQUISITION IN THE GOAT: AN ETHOLOGICAL APPROACH

(Publication No. 18,280)

Bernard Everett Lyman, Ph.D.
Cornell University, 1956

Liddell has suggested that the motive power for conditioned response acquisition is the organism's generalized alertness or vigilance. He believes vigilance is made manifest at the skeletal level in what Pavlov termed the investigatory reflex or orienting response. This research was designed to investigate the role of vigilance in conditioned avoidance acquisition.

Eleven female goats were trained in conditioned avoidance flexion of the right forelimb. The conditioned stimulus was a 10 second buzzer, and the unconditioned stimulus was a mild electric shock. The interval between successive trials ranged from 30 seconds to three minutes and 30 seconds with a mean of two minutes. The criterion of learning was a fixed ratio of two for avoidance responses to unconditioned responses plus the stipulation that there be 10 consecutive avoidance responses to the daily total of 15 signals. Although special attention was given to the

orienting response, in the belief that vigilance would be made manifest in other behaviors, all gross overt responses were observed and recorded.

Frequency trends were computed for each kind of behavior occurring under four conditions: (a) signal periods preceding avoidance responses, (b) signal periods preceding unconditioned responses, (c) intervals following avoidance responses, and (d) intervals following unconditioned responses. For each behavior, the trends for the two signal conditions were compared as were the trends for the two interval conditions. Where applicable, the *t* test for matched pairs was employed for testing the significance of the difference. When this was not applicable, Wilcoxon's Signed Ranks Test for matched pairs was applied.

Six Major results were obtained:

- (a) A significant negative correlation exists between the vigilance level evoked by the CS and trials to learn the avoidance response.
- (b) During signal periods a significantly higher vigilance level precedes avoidance responses than precedes unconditioned responses.
- (c) The acquisition of avoidance flexion appears to be sudden and abrupt rather than prolonged and gradual.
- (d) The significance of the CS and the US appears to change for the organism once adequate flexion has emerged.
- (e) Late in training, the animal appears somewhat more tense following avoidance responses than following unconditioned responses.
- (f) Drive reduction, either in terms of alertness or tension, appears not to occur in such a way as to account adequately for avoidance acquisition.

The general conclusion is that the conditioned stimulus, as any novel stimulus, has an alerting power of its own. Through contiguous association with the unconditioned stimulus that alerting power is increased. The organism's increased level of alertness facilitates performance and at the same time facilitates learning. The adequate response becomes more readily associated with the conditioned stimulus. Vigilance, then, is the mediating response which sets the stage or lays the groundwork for the specific action of the impinging conditioning stimuli. This vigilance is a response to the total situation, not only to the stimuli to which adjustment is made, but to the adjustive act itself and to the relationship of this adjustive act to those stimuli.

101 pages. \$1.50. Mic 56-2734

TIME PERCEPTION AS AFFECTED BY MOTIVATIONAL LEVEL, GOAL DISTANCE AND RATE OF PROGRESS

(Publication No. 17,251)

Robert D. Meade, Ph.D.
University of Pennsylvania, 1956

Supervisor: Dr. Francis W. Irwin

This dissertation was an extension of the work of Hindle who found that time perceptions are inversely related to

perceived rate of progress when perceived distance traveled is held constant. The present investigation presented a formulation whereby locomotion through a given activity may be regarded as being of two kinds. When there is some degree of motivation to reach the end of a task, locomotion through this task was regarded as locomotion with progress. When there is no motivation to reach the end of a task, locomotion through this task was regarded as locomotion without progress. Therefore, Hindle's equation

$$\text{Perceived time} = \frac{\text{Perceived distance traveled}}{\text{Perceived rate of progress}}$$

was predicted to hold for the first condition but not for the latter.

Hindle had also indicated that the gradient of attractiveness extending from the goal was important for time perception. The present investigation assumed that the nearer to the goal that the subject was interrupted the shorter the perceived time would be. It was also predicted that changes in rate of progress would have greater effect nearer to the goal than at distances farther from the goal.

The experiment utilized a stylus maze with subjects moving through the maze at different rates of progress and being interrupted at different distances from the goal for time estimates. An attempt was made to bring about two conditions of motivation by instructions to the subjects. Both groups of subjects in the motivational conditions were told that they would have to spend a long time working on boring and tedious tasks. The low motivation group was told that there was nothing that could be done to shorten this time and that it did not make any difference how well they performed--they still would have to spend the same amount of time. The high motivation group was told that they could be excused from most of the experimental tasks if they did well on the first one.

The data of the experiment justify the following conclusions:

1. Perceived rate of locomotion has no effect on perceived time if the subjects are under low motivation to finish the task.
2. When subjects are under some positive degree of motivation to reach the end of a task, perceived time is inversely related to perceived rate of progress.
3. When subjects are under low motivation to reach the end of a task, perceived time is independent of perceived distance from the end of that task.
4. When subjects are under some positive degree of motivation to reach the end of a task, perceived time is shorter the closer the subject is to the goal.
5. Changes in perceived rate of progress have a greater effect the closer the subject is to the goal.

It is suggested that a possible reason for conflicting results in earlier studies of time perception is lack of control of motivational variables.

51 pages. \$1.50. Mic 56-2735

THE EFFECT OF EXTRANEIOUS AUDITORY STIMULATION ON VISUAL PERCEPTION

(Publication No. 18,082)

Thomas Basil Mulholland Jr., Ph.D.
Clark University, 1956

Supervisor: Heinz Werner

The purpose of this thesis was to study by the experimental method the effect of extraneous auditory stimulation on visual perception. The experiments show that background tones can affect certain visual illusions in a manner equivalent to the effect of actually changing the brightness contrast between a rotating stimulus object and its background.

The rotating stimulus object, which was viewed against a homogeneously illuminated background, generated a variety of visual illusions. Two experimental measures were used: the number of times each of these visual illusions of motion was reported; and the time that elapsed before each illusion was reported. These measures showed that two of the illusions of motion were definitely determined by the amount of contrast between the rotating stimulus object and the background. As the background became brighter one kind of perceived motion became more likely to occur, while the other became less likely to occur. Thus, these illusions could be used as an index of the amount of contrast between the stimulus object and the background.

It was also found that the likelihood of these illusions occurring was different when an auditory tone was present than when it was not. By presenting the tone in conjunction with various degrees of stimulus object-background brightness contrast it was found that the tone, in general, had an effect on the illusions equivalent to brightening a dark background or darkening a light background. In short, the tone had an effect equivalent to reducing the contrast from extreme to more intermediate values.

This "contrast-reducing" effect of tone varied depending on the frequency of the tone and the time of exposure to the tone. Low frequency tones showed this effect to a greater degree than high frequency tones, and the effect diminished as time of exposure to the tone increased.

The results were interpreted in the general context of Werner's developmental theory with particular reference to the concept of differentiation. It was concluded that the effect of tone was equivalent to a de-differentiation of the brightness contrast in the visual field, that this effect was greater for low frequency tones and that the effect diminished as time of exposure to the experimental situation increased.

175 pages. \$2.30. Mic 56-2736

AN INVESTIGATION OF THE EFFECTS OF RED AND GREEN SURROUNDINGS ON BEHAVIOR

(Publication No. 18,333)

Jacob Sarkis Nakshian, Ph.D.
The University of Connecticut, 1956

This study investigated three main hypotheses derived from Kurt Goldstein's theory concerning the differential

effects of red and green wall surroundings on behavior.

Hypothesis I stated that the efficiency of performance on tasks requiring relatively fine psychomotor coordination will be greater under green than under achromatic and greater under achromatic than under red. From Hypothesis I, predictions were made as to performance on a hand tremor task, a tweezer dexterity task and a task - based on the Downey Motor Inhibition test - where subjects were instructed to trace an arc as slowly as possible.

According to Hypothesis II, the accuracy of psychophysical judgments will be greater under green than under achromatic and greater under achromatic than under red. Hypothesis II was tested by means of tasks measuring the accuracy of judgments of length and of reproduction of time intervals.

Hypothesis III was as follows: red, as compared to achromatic, will have an expansive, and green, as compared to achromatic, will have a contractive, effect on the performance of arm movements made laterally both away from and toward the vertical midline of the body. From Hypothesis III, it was predicted that under red, as compared to achromatic, there will be: (a) a greater final distance between the arms when subjects are instructed to move both their arms laterally outward to an outspread position which feels "most comfortable"; (b) a greater final distance between the arms when subjects are instructed to move both arms laterally outward until a distance of ten inches separates the arms; (c) a faster rate of speed for arm movements made laterally outward from the vertical midline of the body at a "pleasant" rate of speed and; (d) a slower rate of speed for such arm movements when made laterally inward toward the vertical midline of the body. It was further predicted that green, as compared to achromatic, will have effects on the performance of these tasks which are opposite to the relative effects attributed to red.

The main apparatus consisted of a rectangular, semi-enclosed structure with painted walls. The subjects, when seated in front of the structure, were surrounded on three sides by the colored surfaces. Each of the 48 normal adult subjects (24 males and 24 females) performed the tasks under red, green, and achromatic wall surroundings.

The main results were:

1. There was significantly greater hand tremor under red than under green ($p < .001$). There was also greater hand tremor under red than under achromatic ($.07 > p > .05$). The green-achromatic mean difference was in the predicted direction but did not approach significance. On the Motor Inhibition task, the speed of movement was significantly faster under red than under green ($p < .05$). The red-achromatic and green-achromatic mean differences were in the predicted direction but did not achieve significance. The results from the Tweezer Dexterity task were negative. The above results were interpreted as offering limited support to Hypothesis I.

2. The results offered no support for Hypothesis II.

3. The results offered no support for Hypothesis III.

4. The results from the Hand Tremor task suggested that the impairing effect of red on the efficiency of hand tremor performance tends to decrease as a function of increased mastery of the task.

5. The ranking of the three color conditions by the subjects in terms of relative preferability as conditions under which to work revealed the following order of increasing preference: red, achromatic, and green.

146 pages. \$1.95. Mic 56-2737

THE EFFECT OF LITERAL AND
POETIC ORIENTATIONS ON THE
MEANING STRUCTURE OF WORDS

(Publication No. 18,087)

Lillian Gottesman Raeff, Ph.D.
Clark University, 1956

Supervisor: Heinz Werner

The aim of this study has been to examine the effect of different temporary and permanent orientations towards language upon the structurization of verbal concepts. Based on considerations derived from H. Werner's developmental psychology and E. Cassirer's epistemology, the general hypothesis has been that poetic apprehension of verbal concepts exploits less differentiated forms of cognition as compared to prose apprehension. Such relatively undifferentiated forms of cognition imply a lack of separation of objective and subjective experience, a fusion of perception and striving, of percept and conception.

The design of this study utilized a combination of interview and scaling techniques. Three groups of subjects were selected differing in terms of their more or less permanent orientations towards language (9 poets, 15 "appreciators" of poetry, and 15 "non-appreciators" of poetry). The subjects were instructed to adopt first a prosaic attitude, then a poetic attitude towards words.

Using five experimental words, 'velvet', 'stream', 'stone', 'diamond', and 'fog', every subject was asked to list the properties of each verbal concept, first taken in a prose context and then in a poetic context. The subject was asked to order on two separate scales the properties of each verbal concept in terms of its importance within each particular context - prose or poetry. Finally, the subjects had to state whether, and in what way, the properties mentioned for each word were related to each other.

The raw data were analyzed in regard to two general categorical aspects: one analysis dealt with the properties of the verbalized concepts, the other with the relationships among these properties.

Two judges independently ordered the responses given by the subjects into prescribed categories. There was high agreement between the judges.

To determine the effects of the subjects' temporary prosaic and poetic orientations on the structurization of verbal concepts, the number of responses given by each subject under each category was compared with regard to the two orientations. The significance of any difference was assessed by the Sign Test. It was found that words conceived poetically are assigned significantly more concrete-sensory properties (i.e., terms referring to visual, auditory, thermic, etc. properties) than are the same words conceived prosaically. The semantic sphere of "poetic" words included also a relatively greater number of terms designating synaesthetic, "physiognomic" and other expressive properties. Furthermore, in poetic orientation, the verbal concepts were predominantly conceived in contexts of a "suggestive-imaginative" type, in contrast to the factual-utilitarian contexts under prosaic orientation. The relationships among properties of "poetic" words were often synecdochic and based on the inner experience of the subject, in contradistinction to the relations among properties of "prosaic" words which were predominantly "logical" and "factual" in character. A high degree of cohesiveness

was found among the properties of poetically conceived objects, while the properties of prosaically conceived objects were found to be more sharply separated in terms of their relative importance to the verbal concept.

A final analysis concerned the effects of more or less permanent orientations on the apprehension of verbal concepts. Here the three groups of subjects were compared with regard to the relative frequency of responses within each category of analysis in the poetic orientation. It was found that the permanent poetic orientation as found in poets intensifies the temporarily induced poetic orientation, while a relatively permanent technical orientation was found to lessen the efficacy of a transitory poetic orientation.

These qualitative and quantitative findings support the original hypothesis that a poetic orientation - whether temporary or more or less permanent - involves the utilization of cognitive processes genetically earlier (less differentiated) than those evoked in a prosaic orientation.

In conclusion, we may state that a poetic as compared to a prosaic perspective leads to positing different kinds of properties of objects, and to differences in the types of relations among the object-properties.

96 pages. \$1.50. Mic 56-2738

SELECTIVE RECALL OF COMPLETED AND
INCOMPLETED TASKS AS A FUNCTION OF
AGE AND INSTRUCTIONS

(Publication No. 17,142)

Kathryn Magaw Ralph, Ph.D.
University of Washington, 1956

Review of research on selective recall of completed and incompleted tasks reveals there is strongly divergent opinion as to whether the Zeigarnik effect exists as a group phenomenon and, if so, as to what its influence may be in studies using the interruption technique as a procedure. Although recent studies provide a theoretical approach to investigation of selective recall of adults under varied instructions, there is no consistent data available for children. In particular, it is important to know whether group trends in selective recall of completed and incompleted tasks can be demonstrated in children by use of the interruption method and, if so, whether the group trends in their selective recall can be demonstrated to undergo any systematic changes as a function of age and alteration of instructions.

This experiment, therefore, was set up to investigate the following hypotheses:

- Hypothesis I. Randomly selected children of a given age-group will demonstrate the Zeigarnik effect under task-orientation.
- Hypothesis II. Randomly selected children will demonstrate an increased Zeigarnik effect with an increase in age under task-orientation.
- Hypothesis III. Randomly selected children in a given age-group will recall more completed tasks under ego-orientation than they do under task-orientation.

Hypothesis IV. Randomly selected children in a given age-group will recall fewer incompleting tasks under ego-orientation than they do under task-orientation.

Hypothesis V. With increase in age, randomly selected children will recall an increased number of completed tasks and a decreased number of incompleting tasks under ego-orientation in comparison with selective recall under task-orientation.

To test these hypotheses, a group of 30 six year old boys and a group of 40 nine year old boys did 16 jigsaw puzzles, half of which were completed and half of which were interrupted about midway to completion. In Session I, all S's were treated identically under task-oriented instructions. Each group then was divided into control and experimental groups at random. In Session II, the control S's were given the puzzles again under task-oriented instructions, and the experimental S's repeated the puzzles under ego-oriented instructions. Immediate incidental recall of tasks was obtained following each session.

Statistical analysis of selective recall of these groups failed to confirm all but one hypothesis. Namely, nine year old S's showed the Zeigarnik effect as a group at the .02 level of confidence. These results are discussed in relation to the findings of other workers with respect to adults and children.

It is concluded there is no legitimate basis for discarding interruption as an experimental procedure at this point. However, until there are additional normative data available on the operation of the selective recall of completed and incompleting tasks at different age-levels and under varied instructions, interruption technique probably is not the appropriate method for study of more complex, dynamic processes such as repression, ego-strength, and similar theoretical constructs.

87 pages. \$1.50. Mic 56-2739

A STUDY OF ADAPTATION TO TILT

(Publication No. 17,018)

James Thomas Ray, Ph.D.
Tulane University, 1956

Chairman: Dr. Cecil W. Mann

The problem of this paper is concerned with the effect that translation and rotation of the vestibular apparatus has upon the index of adaptation to tilt, as well as the manner in which the adaptation effect is distributed with respect to repeated trials (habituation), the degree to which the habituation effect in one quadrant can be transferred to the opposite quadrant, and the retention of habituation over a period of time.

The general study has been divided into two separate experiments. In Experiment I the influence of five factors upon the index of adaptation to tilt was investigated. These are: (1) translation of the vestibule, (2) rotation of the vestibule, (3) the manner in which the adaptation effect is distributed with respect to repeated trials, (4) the amount of transfer of habituation from one quadrant to the other,

and (5) quadrant differences in the index of adaptation.

The experimental design was based upon the matrix formed by the combination of the experimental values for each of three parameters: direction of initial tilt (right or left), translation of the vestibule (0, 5, or 10 inches), and rotation of the vestibule (15, 30, or 45 degrees). The combinations of these experimental values formed a matrix of 18 cells. Each cell forms one condition of the experiment. One of the 18 independent 5-subject groups was assigned to each cell.

The results of this experiment were: (1) that no statistically significant effect was found for the factor of translation, (2) that no significant effect was found for the factor of direction of initial tilt, (3) that a highly significant effect was found for the factor of magnitude of tilt, (4) that almost complete positive transfer of the habituation effect, from one quadrant to the other was found, (5) that a trend for the index of adaptation to diminish with repeated stimulation was found, and, (6) that the main experimental effects were not found to interact significantly with one another.

Experiment II was an investigation of the adaptation process (1) where the inter-session rest periods are interspersed at various stages of practice and (2) where retention of habituation was measured after a 7-day rest interval.

In this experiment S was tilted to his right to an inclination of 15 degrees from the gravitational vertical and with 5 inches of vestibular translation. Ten Ss were assigned to this condition and for each S the entire condition was sampled in 5 separate sessions spread over a two-week period.

The results of Experiment II were: (1) that in each case the constant error of adjustment immediately following a rest interval was found to be greater than that immediately preceding the rest interval, (2) that the initial block mean for each experimental session was found to decrease systematically in value as the sessions progressed, and, (3) that retention of the habituation effect was found to be almost complete over the 7-day period.

Mathematical models have been developed to describe the results of these experiments within the boundary conditions set for each of the experimental parameters. The fit between the predicted and empirical values is good and the models have been generalized to cover the range of experimental conditions.

Further, nine points are enumerated which must be accounted for to give an adequate description of the empirical phenomena of vestibular stimulation resulting from lateral tilt.

105 pages. \$1.50. Mic 56-2740

CONCEPTUAL FLEXIBILITY IN GROUPING BEHAVIOR

(Publication No. 18,198)

Pearl Schroeder, Ph.D.
University of Illinois, 1956

Conceptual flexibility in a problem situation (grouping task) was studied as a function of the effects of previous practice of differentiating responses to various aspects of training materials. These responses were varied two ways

in terms of their relevancy to the subsequent problem and four ways in terms of the method whereby S acquired them during practice. Operationally defined, conceptual flexibility was the number of different ways S could group 12 non-identical blocks according to consistent principles which yielded mutually exclusive groups. The six basic dimensions of the blocks which determined all 27 possible solutions were highly familiar ones, utilized to control for pre-experimental experience. The relationship of the number of solutions found and the accuracy and level of abstraction of the verbal behavior describing the principle of solution was also investigated. The Ss were 90 seventh-grade children.

An analysis of variance of the total conceptual flexibility scores of the eight experimental groups showed no significant differences associated with the relevancy of the practiced responses, the method of acquisition, or their interaction. Comparison with a control group showed no significant positive or negative effects. The only demonstrable effect of the training conditions upon conceptual behavior was a temporary one upon initial solution choice. The control group and all groups trained on aspects not relevant to the problem used much the same solutions on the first trial, while the groups trained on aspects relevant to the problem used different solutions. This difference varied within the "relevant" groups according to the degree of exploratory power assumed to have been inculcated by the different methods of acquisition. It was suggested that, contrary to the assumption supported by the results of an exploratory study, the use of problem materials with highly familiar dimensions precluded the demonstration of the effects of the independent variables. Further comparison of the exploratory and experimental studies indicated that uncontrolled differences in the level of emotional stress might account for the differences in obtained results. It was suggested that the effects of stress upon conceptual flexibility in a grouping task be investigated further.

The obtained relationship between the non-verbal and the verbal behavior in the grouping problem was significant but, contrary to prediction, curvilinear. When solutions were divided according to frequency of use into popular and rare, the relationship for the popular solutions, beyond a minimal level of verbal identification, was asymptotic; that for the rare solutions was significant, positive, and linear.

The relationship of simple and combination solutions was examined according to the theoretical presentation of problem-solving underlying the study. The findings here were consistent with the theoretical view that analysis of problem materials, although it does not insure solution, does play a necessary and limiting role in problem solving.

168 pages. \$2.20. Mic 56-2741

THREAT TO THE SELF, THE DIRECTION AND BREADTH OF ATTENTION, AND THE DISTANCE GRADIENT

(Publication No. 17,276)

Thomas E. Shipley, Jr., Ph.D.
University of Pennsylvania, 1956

Supervisor: Julius Wishner

Two experiments were performed to test the general hypothesis suggested by Asch that Ss under a threat orientation will show less task interest than will Ss not under a threat orientation. Task interest was measured by (1) time spent in the judgment of preference for one of two pictures offered as rewards for participation in an experiment, (2) the number of times the S looked at each picture (VTE), and (3) the number of details of each picture recalled. An additional hypothesis stated that the distance gradient would be more pronounced under threat than under a non-threat orientation. The distance gradient was measured by the preference for the immediate as opposed to the deferred reward picture.

The procedure for both experiments involved orienting each S cooperatively or competitively toward an initial task, rewarding each S for her participation in the experiment, asking for her preference of reward pictures, and finally requiring each S to write a description of both pictures.

The results of Experiment I were ambiguous. The time and VTE scores were in the predicted direction but were not significant. The recall scores were in the opposite direction but again were not significant. The two orientation groups differed significantly with respect to the effect of the distance gradient upon their preference. However, the cooperative non-threat group showed a trend toward a preference for the deferred reward. Consequently, both groups may have been influenced by the distance variable in opposite ways. This trend is discussed in terms of the two orientations and the S's relationship to the E.

Experiment II was performed in an attempt to correct an apparent difficulty in the procedure of Experiment I. From the inquiry of the Ss in Experiment I it was apparent that many of the Ss suspected the appropriateness of the reward. Consequently Experiment II is a replication of Experiment I except the pretest was lengthened. An analysis of the results of Experiment II indicates that the attention measures were all in the predicted direction. The two orientation groups differed significantly upon the time and VTE scores, whereas the recall scores did not differ significantly. The two orientation groups likewise, differed significantly on the time and VTE scores for both experiments combined. Although the distance variable showed no effect in this experiment, this can be explained on the basis of a significant preference for one of the reward pictures in the group as a whole.

An analysis of the reasons for preference indicated that more Ss under the competitive threat orientation than under the cooperative non-threat orientation based their preferences upon the clarity of the pictures. Those Ss who gave such a reason also spent less time in stating their preference. These results are discussed in terms of task-centered attention.

58 pages. \$1.50. Mic 56-2742

SOCIAL PSYCHOLOGY

CONFORMING BEHAVIOR IN TWO GROUPS OF ADOLESCENT CHILDREN AND ITS RELATION TO CERTAIN PARENTAL ATTITUDES AND PERSONALITY CHARACTERISTICS

(Publication No. 18,275)

Francis Goodale Hugo, Ph.D.
Cornell University, 1956

This study deals with the incidence of conforming behavior in two age groups of adolescent children and explores the relation between conforming behavior in children and certain parental attitudes. Conforming behavior is experimentally induced by artificially created social pressure which is exerted to cause subjects to alter their judgments about relatively simple stimulus materials. The parental attitudes investigated are "authoritarianism" and restrictiveness toward child-rearing practices.

The subjects in the conformity experiment are fifty 14-year-old 9th grade and fifty 17-year-old 12th grade high school boys and girls. The subjects in the study of parental attitudes are parents of 30 children who are either extremely suggestible or extremely non-suggestible in the conformity experiment.

An apparatus is used to create a situation in which each subject believes himself to be the last of a group of five subjects to answer certain questions and that the others have given answers different from his. A "conformity score" is calculated based on the frequency with which a subject alters his originally correct answers, given on a prior control test, to agree with erroneous, experimentally induced group answers. Parental attitudes in respect to "authoritarianism" and restrictiveness are measured by individually administered questionnaires. The questionnaires are composed of a 10-item F scale and a 23 scale 5-item inventory of attitudes toward family life and children. The chi square statistical technique is used to test the significance of the differences between the distributions of "conformity scores" for the various age and sex groups.

Overall per cent of conforming responses by the adolescent subjects in this experiment is found to be slightly less than that reported by other investigators for other age groups. There are large individual differences in frequency of conforming among both younger and older adolescents. The 9th graders as a group are significantly more conforming than the 12th graders. The girls at both grade levels are on the average more conforming than the boys, but this difference is statistically significant only at the 12th grade level. Conformity occurs most frequently on difficult, ambiguous items and least frequently on items calling for personal, subjective judgments. It is also found that parents of extremely suggestible children in this study tend to express more authoritarian attitudes and to be more restrictive in their attitudes toward child-rearing practices than parents of extremely non-suggestible children, although these differences are not tested for statistical significance. Parents who have predominantly girl children are also found to be more restrictive in their attitudes than parents with predominantly boy children.

The results of this and other studies suggest that conformity tends to decrease and independence to increase with age. Adolescents as a group do not appear to be atypical in this respect, nor do they appear to display an unusual amount of conforming behavior as compared to other age groups. There is evidence of an interaction between age and sex in the development of independence of judgment, with the girls tending to lag somewhat behind the boys in acquiring this characteristic. This may be attributed to differential training, cultural expectations, and the changing nature of the social requirements to which girls must adjust in developing their sex roles. It is also concluded that the results of this study do not oppose a theory that some cases of extreme suggestibility in children may result from restrictive, authoritarian, parental discipline. Several hypotheses about the incidence and antecedents of conforming behavior in childhood and adolescence are suggested as guides for future research in this area.

167 pages. \$2.20. Mic 56-2743

FOSTERING COOPERATIVE ATTITUDES IN CHILDREN THROUGH AN ACTION PROGRAM

(Publication No. 18,300)

Frederica Young Jefferson, Ph.D.
Cornell University, 1956

Ashley-Montagu and others have indicated that cooperation is a desirable form of social behavior and have announced the need for research in this area. The present study has attempted to indicate that cooperative attitudes can be fostered through an action program in which children have an opportunity to discuss and act out their differing opinions and attitudes. It has also attempted to indicate that a projective test may be used as an index to cooperative attitudes. Some of the secondary questions included the relationship between sociometric status, direction of frustration, and quality of group interaction to cooperative attitudes. Cooperation refers to "A one-to-one relationship to which there is consideration each for the other which results in mutually beneficial activity."

The subjects were 16 boys and 10 girls enrolled in a local first grade class, between the ages 6.3 and 7.8. Most were from fairly low socio-economic homes. They were administered a projective test (Picture Preference) and on the basis of their responses were then used in the experiment or rejected. The subjects were randomly assigned to (1) a control group, (2) a knowledge group - which listened to a story which purports to foster cooperative attitudes - or (3) an action group - which presented two problematic situations - to which they role played and discussed possible solutions. All groups were given a post test and their two sets of responses to the projective test were then analyzed. Additional data included responses to the Rosenzweig Picture Frustration Test and sociometric tests, be-

havior ratings and discussion records.

The relevant findings are summarized below:

1. Only the action group, in which an opportunity was provided to become acquainted with the social norm through role playing and group discussion, reflected a significant increase in cooperative attitudes in the post-training test.
2. Within the action group, the cooperatively oriented child gave more positive responses than the non-cooperatively-oriented child.
3. The cooperatively-oriented child tended to have higher sociometric status in the group.
4. The children did not have differing patterns of frus-

tration on the Rosenzweig, although as a sample they differed from the Rosenzweig norms.

5. The cooperatively-oriented child tended to be seen as less of a classroom behavior problem than the non-cooperatively-oriented child.

These findings may be interpreted encouragingly by those who wish to establish satisfactory peer relationships among children. Training in live thinking with a focus on cooperation with others can be an important first in preparing our children for active participation in their primary groups; the classroom may be the logical place for such training to begin.

132 pages. \$1.75. Mic 56-2744

SOCIOLOGY

SOCIOLOGY, GENERAL

PREDICTING FRIENDSHIP BEHAVIOR: A STUDY OF THE DETERMINANTS OF FRIENDSHIP SELECTION AND MAINTENANCE IN A COLLEGE POPULATION

(Publication No. 18,269)

Carlfred Bartholomew Broderick, Ph.D.
Cornell University, 1956

The object of this thesis is to so organize the field of friendship behavior as to make possible reasonably precise predictions over time. An extensive analytical review of the theoretical and research literature yielded a system of propositions about friendship behavior. Some of the most important propositions had not been adequately tested in previous research. The first step in the predictive process was to validate these propositions empirically.

The subjects of the study were 93 college girls in an elementary course in Child Development and Family Relations. They were given a sociometric test and values inventory on the first day of the semester and again three months later. By using the 52 reciprocal pairs which existed at the time of the first sociometric test, the following propositions were systematically tested:

1. Status (or Value) homophily is an important factor in selective friendship behavior.
 - 1a. The greater the number of different kinds of statuses (or values) two persons have in common, the greater will be the positive valence between them.
 - 1b. The greater the degree of similarity between two individuals with respect to any given type of status (or value), the greater will be the positive valence which that similarity will contribute to the total valence.
 - 1c. The greater the psychic or social significance of a given type of status (or value), the greater positive valence similarity with respect to it will add, and the greater negative valence dissimilarity will add

to the total valence.

2. No friendships can develop or be maintained without contact.

- 2a. Holding net valence (resultant) of the first set of propositions constant, friendship formation will vary inversely with difficulty or infrequency of contact.

In each case the data supported the proposition. This was more strikingly true in the case of contact and status variables than in the case of value variables.

The second step was to use these propositions as a guide in predicting changes in the sociometric status of pairs over the three month period. A series of seven prediction zones was developed, Zone I including pairs who were least likely to be friends at the end of three months and Zone VII including pairs who were most likely to become friends in this period. The use of these zones made it possible to predict friendship behavior with an accuracy which not only exceeded chance but was reasonably precise. Error cases were few enough to be considered in detail.

The bibliography includes 132 titles.

300 pages. \$3.85. Mic 56-2745

THE PROFESSIONALIZATION OF LABOR IN DETROIT

(Publication No. 18,297)

Nelson Northrup Foote, Ph.D.
Cornell University, 1956

Professionalization is defined as the process whereby an occupation becomes a profession. This process is broadly described as the raising of technical, social and ethical standards of the occupational group, to the point where its aspiration and claim to professional status are ratified by the community through some formal institution. Labor is represented by hourly-rated auto workers who

belong to the United Auto Workers Union. Since the standards of their group are being raised quite rapidly along all these lines, it is argued that they are becoming professional, and this process will be confirmed and facilitated as they themselves apply this concept to their behavior.

The more important trends and events affecting the conditions of labor in Detroit are sketched for the past two decades. Detroit is presented as the prototypical city for study of such transformations. Accumulating clauses in the contract between General Motors and the United Auto Workers are taken as the most indicative log of the history that is being made there through explicit negotiations.

Current aspects of the context which conditions further developments are then analyzed under nine chapter headings:

Historical
Economic
Technological
Educational
Psychological
Sociological
Political
Ethical
Anthropological.

A conspicuous manifestation of each aspect of professionalization furnishes the focus for documentation and interpretation:

The annual wage represents achievement of salaried status.

The generalization of processes through increasing research and automation is upgrading the skills of the labor force along the axis of abstract principles and higher responsibility.

Continual reorganization of work threatens displacement of workers who cannot continually re-learn. Demand for re-training opportunities coincides with a shortage of technical manpower, which means the existing hourly-rated group through upgrading is a larger potential source than the colleges.

Among young people graduating from high school, aspirations to attend college, enter a profession and pursue a career have become almost universal. Even the generation of Detroit labor which has been at work for the past two decades more embraces the career concept in looking ahead.

Both the union and the corporation as institutions show growing similarities to the professional society, while among the professions which are salaried there is a trend toward unionization.

The tripartite principle in industrial relations has fostered adoption of professional attitudes toward conflict.

A higher degree of responsibility and other ethical attributes is being demanded of and by labor in industry.

The view of social relations as constituted by the "living document" theory of the corporation and the union implies the planning of personal careers as themselves living documents of an evolving conception of the autonomous professional man.

These major foci are accompanied by minor items of evidence and an effort to interrelate the nine aspects as a coherent movement from rural individualism through industrialism to professionalism.

180 pages. \$2.35. Mic 56-2746

SOME FACTORS INFLUENCING WOMEN TO CHOOSE CHURCH-RELATED VOCATIONS: A STUDY IN OCCUPATIONAL SOCIOLOGY

(Publication No. 17,473)

Irene Christine Linder, Ph.D.
State University of Iowa, 1956

Chairman: Professor Harold W. Saunders

The purpose of this research was to make a study of some social factors which may have functioned in such manner as to have influenced women to choose church-related vocations. This study was predicated on the assumption that a similar pattern of social conditions and attitudes was functioning for women who chose church-related vocations and that the pattern was different for those entering other positions.

The subjects of this study consisted of two groups: one group was composed of ninety-eight women training for church-related vocations, and the second group was composed of sixty-one women entering vocations under other than church auspices. Two instruments were used to obtain data. The Twenty-Statement-Test served as a personality test and a questionnaire was used to elicit statements regarding family background, occupational values, meaning of religion and recognized factors influencing vocational choice. Chi square was the primary means of analysis.

Six major hypotheses derived from a sociological orientation consistent with symbolic interaction and structural-functional analysis were tested. The major findings are as follows:

Personality defined as self-attitudes was found to differ for the two vocational groups. The church-related group had significantly more religious and less family self-concepts. Religious reference groups were more prevalent and influential for the church-related group and the family was more influential for the control group. Identification with religious reference groups provided the motivation for the church-related group. Desire to do the will of God and to serve mankind, which was viewed as agreement with the will of God, were motives for vocational choices.

The social factors operating in the family backgrounds of the church-related group differed significantly in several aspects and differences of lesser degree reinforced the pattern. These women were not as aware of social class and more likely to be from low class families. While the mothers had more education, and the fathers tended to have more, financial success was not so great. The parents were not as likely to go to church and they were more likely to oppose their daughters' vocational choices. These subjects were more likely to be unhappy in their relationships with their parents. The fathers displayed more negative reactions to mother domination and parents differed significantly in their attitudes toward drinking. There were trends toward more intoxication, alcoholism, uncertainty regarding sexual unfaithfulness of parents, broken homes resulting from separation and divorce, and more living in homes of one parent, institutions or a series of living arrangements.

The church-related group was significantly influenced by personal and intimate religious experiences in making their vocational choices. They desired to express gratitude through their vocation.

Women entering church-related vocations held more

intrinsic values when attitudes toward monetary rewards and desire for children were evaluated. They anticipated lower beginning pay, lower maximum earnings and saw smaller incomes as being adequate for a family. They significantly wanted more children and more often desired what they considered to be the ideal number. They were significantly a more downward mobile group.

The findings of this study lead to the conclusion that many factors influence occupational choice. Among these factors are personality viewed as self-attitudes, reference groups, personal identification, societal factors in the family backgrounds, meaning of religion, and occupational values. Women entering church-related vocations appear to form two sub-groups. One includes those whose family backgrounds are stable, wholesome, and economically secure and in which religion functions as an expected means of daily adjustment. The second includes those from more unstable, disorganized and unhappy family backgrounds and religion becomes the means of adjustment in such stressful conditions.

291 pages. \$3.75. Mic 56-2747

A ROLE THEORY APPROACH TO PREDICTING ADJUSTMENT OF THE AGED IN TWO COMMUNITIES

(Publication No. 18,284)

Bernard S. Phillips, Ph.D.
Cornell University, 1956

This study originates in the problems of adjustment faced by the aged population. Its primary purpose is to test the utility of a role theory approach to the prediction of adjustment.

Data are based on interviews with 500 respondents in the Kips Bay-Yorkville Health District of New York City and 468 respondents in Elmira, N. Y. Interviews were held with probability samples of the non-institutionalized aged populations sixty years old or older in the two areas. Although the analysis was not undertaken chiefly for comparative purposes, this aspect of the data (1) aided replication, providing additional confirmation for results, and (2) provided a wider range of variation in the variables under consideration than could normally be obtained in studying a single area.

Adjustment is conceived of as a state in which needs are satisfied by rewards. The measure of adjustment is a Guttman scale of three items, habitual absent-mindedness, daydreaming about the past and thoughts of death. It is posited that such patterned fantasy behavior indexes a lack of alignment between the needs of the individual and the rewards he obtains. Criterion-oriented validation procedures show this index to be significantly related to (1) a satisfaction-with-life Guttman scale based on four items having to do with general happiness, and (2) items indexing rigidity, i.e., failure to adapt behavior to changing conditions without overt signs of frustration. Finally, the index is shown to have a fairly high degree of construct validity in that its association with the independent variables utilized is generally corroborated by past research.

Three role "dimensions," diffuseness, extensiveness, and frequency, are distinguished. Together they provide

an index of rewards involved in conforming to the prescriptions of a given role. Propositions relating to four general role-areas are tested: marital roles, employment roles, friendship roles, and activity roles. These propositions are basically of two types: (1) those relating maladjustment to low extensiveness or low frequency, and (2) those relating maladjustment to degree of role change involving a reduction in frequency, extensiveness, and/or diffuseness.

In each of the four role-areas considered, the relationship between role change and adjustment is statistically significant. Propositions relating extensiveness and frequency to adjustment receive little support.

The self-image is conceived of as a very general perceived role, one aspect of which is age-identification or felt age. Felt age affects adjustment in at least two ways: (1) in a manner corresponding to role changes in the various role-areas, i.e., a shift in identification from "middle-aged" to "old" constitutes a role change involving a reduction in the rewards available to the individual, and (2) indirectly, through a reduction in role extensiveness, which in turn affects adjustment. Results indicate that felt age is more closely related to adjustment than role changes in any of the four role-areas.

Additional results show that age-identification may operate in part as an intervening variable in its effect on adjustment. Role changes in the employment and marital roles, i.e., retirement and death of spouse, respectively, are related to felt age, which in turn is related to adjustment.

Our general conclusion is that we have contributed to demonstrating the utility of a role theory approach to predicting the adjustment of the aged. This contribution has been most convincing in the case of role changes, both in the various role-areas and with respect to age identification. However, we have not proved the utility of the role dimensions of extensiveness, frequency, and diffuseness for predicting adjustment. Consequently, a reinterpretation of these dimensions is made on the basis of the data.

143 pages. \$1.90. Mic 56-2748

SOCIOLOGY, RACE QUESTION

W. E. B. DU BOIS: A STUDY IN MINORITY GROUP LEADERSHIP

(Publication No. 17,269)

Elliott Morton Rudwick, Ph.D.
University of Pennsylvania, 1956

Supervisor: J. P. Shalloo

To classify and appraise the type of minority group leadership which William Edward Burghardt Du Bois represented, an examination was made of leadership typologies in social science. Data on Du Bois's activities were gleaned from his books, articles, editorials, and letters. Correspondence of other Race Relations leaders was examined. Other sources included the Negro press, N.A.A.C.P. board minutes and annual reports. Du Bois and his associates were interviewed. His ideological posi-

tions were studied in relation to social movements with which he was involved, such as the Atlanta Conferences, Niagara Movement, N.A.A.C.P., and the Pan-African Movement. His strategy-tactics were related to those of other leaders such as Washington and Garvey.

Du Bois exemplifies the Protest-Advocate leadership type. He was a leader of ideas and a "mobilizer of public opinion." He opposed Booker T. Washington. Washington was a Conciliationist-Advocate who was essentially an Executive-Administrator type. He made decisions and had authority and force which others respected. A brilliant tactician and organizational genius, he cajoled and harassed opponents. Survival forced Du Bois to become an Executive type, but in the Niagara Movement--and other movements--he equated organization with periodic conferences, and conferences with well-screened guest lists of Negro intellectuals, whom he mistakenly called race representatives. Although an Executive failure, his ability as a propagandist was recognized.

White liberals of the N.A.A.C.P. saved Du Bois from defeat. In the Association he was essentially an Advocate leader, and by default, others assumed executive powers. He was a "pluralist" not an "assimilationist," since he opposed homogeneity and advocated the preservation of racial-cultural differences. However, the theory of cultural pluralism contradicted the realities of American society. After the depression of the 1930's, Du Bois disavowed integration as a present tactic, relegating it to a

long-range goal. Distrusting whites, he emphasized the segregated, socialized economy theory. The N.A.A.C.P. continued to pursue civil libertarianism, affirming its supremacy over the Advocate leader. Du Bois, who once believed his propaganda would "make the N.A.A.C.P. possible," realized his error in failing to influence the organization more directly. The board no longer pretended that he was a national race leader who represented American Negroes, and the members rejected Du Bois's leadership roles which he cherished most. In 1934, he resigned and gradually was embraced by the far-left wing. He is no longer of any great influence in the field of contemporary Race Relations.

As Niagara Movement founder and N.A.A.C.P. propagandist, he was the most prominent enunciator of the equal rights doctrine. Exemplifying the heights Negroes could reach and encouraging racial self-development, Du Bois boosted Negro morale. He demonstrated Negro progress and provided reasons and rationalizations for the failure to achieve. These substantial contributions seem pale beside affirmations that he was primarily responsible for the Negro acceptance of the equal rights ideology and that he was the N.A.A.C.P. policy maker. Although he made serious misjudgments, he deserves to occupy an important position in the history of Race Relations. Despite his individualism, or perhaps because of it, W. E. B. Du Bois was the dean of the Protest Advocate leaders during a large part of the first half of the twentieth century.

707 pages. \$8.95. Mic 56-2749

SPEECH-THEATER

AN EXPLORATORY STUDY OF SOME ASPECTS OF CRITICAL LISTENING AMONG COLLEGE FRESHMEN

(Publication No. 17,461)

Laurence Walter Brewster, Ph.D.
State University of Iowa, 1956

Chairman: Professor Orville A. Hitchcock

This study was an investigation into some of the factors involved in listening to speeches on controversial issues. Two major problems were presented: 1. To investigate the type of statement submitted by student listeners when asked to write a commentary after hearing speeches which contained weaknesses in argument. 2. To determine the ability of students to detect in speeches of this type (a) whether certain ideas were actually stated or implied, and (b) whether certain statements were supported by evidence.

Nine speeches were developed for the study. Each contained weaknesses in argument. The population chosen for the study consisted of 323 students enrolled in Communication Skills classes at the State University of Iowa. Ninety-six per cent were freshmen.

In Part A of the experiment, four of the speeches were presented by tape recording to the students in their regular classroom situations. Students were asked to indicate a

pre-speech as well as a post-speech opinion toward the proposition discussed in each speech, and after each presentation they were given five minutes in which to write a commentary on the ideas expressed by the speaker.

Part B of the experiment was presented to the students one week after Part A. The materials consisted of five tape recorded speeches and a series of statements which the students heard after each speech. Each statement was to be classified into one of four categories. The student was to indicate whether the statement had been stated by the speaker, not stated but implied, or neither stated nor implied. For those statements which he believed the speaker had made, the student was asked to indicate whether or not they had been supported by evidence. A total of 46 such statements were presented to the students. Each student registered a pre-speech as well as a post-speech opinion toward the proposition discussed in each speech.

As a result of the study, the following conclusions were tentatively drawn:

1. When student listeners are told simply to "write a commentary" on a tape-recorded argumentative speech which contains weaknesses in argument, they are unlikely to be critical of the ideas presented. Most students will simply summarize the material.

2. Those students who write critical evaluations of speech containing weaknesses of argument are likely to

have made higher composite scores on entrance tests, such as those given at the State University of Iowa, than those who do not write such evaluations, and are likely to hold an opinion opposite to that of the speaker.

3. Those student listeners who attribute statements to a speaker which he has not said are likely to have made lower composite scores on entrance tests, such as those given at the State University of Iowa, than those students who write critical evaluations.

4. Those students who write critical evaluations of speeches containing weaknesses in argument, are able to make more correct judgments as to whether certain statements were actually made or implied in a speech, and whether these statements, if made, were supported by evidence.

5. The evidence would seem to indicate that male students of the type who participated in the study are inclined to be influenced somewhat less easily than female students by recorded speeches on controversial issues presented by male speakers, and are able to perform slightly better in a test designed to measure some aspects of critical listening.

6. A moderately high correlation exists between the results obtained in the listening test in Part B and measures of reading comprehension and college aptitude.

7. Student listeners may be influenced by recorded speeches regarding controversial issues, even though those speeches are not well reasoned and well-supported presentations.

205 pages. \$2.70. Mic 56-2750

A PSYCHOPHYSICAL STUDY OF VOWEL FORMANTS

(Publication No. 18,142)

Patti Murray Grubb, Ph.D.
University of Illinois, 1956

Nine General American vowels were produced by seven skilled speakers, each of whom approved his own examples as representative. Steady state samples were recorded, each 0.3 second in duration, with sound pressure and fundamental frequency approximately constant. The samples were randomized and presented twice to a group of eight trained observers. At the first presentation the observers attempted vowel identification; at the second presentation they rated the samples on a scale of representativeness. The frequencies of the first three vowel formants were measured and studied in relation to the judgments, with the following results.

1. Coordinate plots of the first two formants were conventional, but the influence of the selective sampling could be observed. The areas were smaller and overlapped less extensively than the areas for unselected samples reported in previous studies. When the samples were restricted to those identified by 75% or more of the observers the areas were smaller and overlap was completely eliminated. In most instances the ratio F_2/F_1 for a given vowel had a range in common with that for at least one other vowel, which should not be the case if the relative theory is a complete explanation. When the identified samples were further restricted to those judged to be most representative most of the areas became extremely small. Adequate differentiation among these areas, how-

ever, was not made by either F_1 , F_2 or F_2/F_1 alone.

2. Similar study of the third formant confirmed the results of past investigations to the effect that F_3 is much less useful in specifying a vowel than either of the lower two formants. As the judgmental restrictions were applied the ranges of F_3 decreased, suggesting that it contributed some information. When the most rigorous restriction was exerted, eight vowels still had a common range of F_3 with /i/ alone being isolated.

3. Self-approval by an expert did not necessarily insure identifiability, and identifiability was not invariably accompanied by high judged representativeness. When a given vowel sample was misidentified or judged to be unrepresentative a plausibly related deviation of F_1 or F_2 was present in most cases. Conversely, most of the atypical values of F_1 or F_2 were reflected in the judgments.

4. In some of the individual speakers deviations of F_1 and F_2 tended to be consistent from vowel to vowel, suggesting the operation of personal acoustic vowel systems. In some of the samples of /ɔ/ only one formant could be distinguished in the lower range. Although such samples were readily identified, they were not among the group judged to be the most representative of that vowel. Non-distinctive concentrations of energy were numerous. One such region was common in the 3000-3500 cps range; others were characteristic of individual speakers. The facility with which the formants of a given sample could be identified visually appeared to be associated with its auditory identifiability.

75 pages. \$1.50. Mic 56-2751

AN EXPERIMENTAL STUDY OF THE RELATIONSHIP BETWEEN THE NOTE-TAKING PRACTICES AND LISTENING COMPREHENSION OF COLLEGE FRESHMEN DURING EXPOSITORY LECTURES

(Publication No. 17,474)

Paul Irving McClendon, Ph.D.
State University of Iowa, 1956

Chairman: Professor Orville A. Hitchcock

The primary purpose of this study was to investigate experimentally the relationship between the note-taking practices and listening comprehension of college freshmen during expository lectures. The effects were studied of four different note-taking methods on listening comprehension during three fourteen-minute tape-recorded expository lectures. An experimental procedure was devised whereby thirty-six randomly selected classes of college freshmen were used as subjects.

The thirty-six classes were divided into three lecture groups, each of twelve classes. Each of these three twelve-class lecture groups was further divided into four subgroups, each of three classes, two average and one advanced. Each subgroup listened to the lecture under different conditions. The first subgroup listened without taking any notes. The second recorded only the lecturer's main points. The third subgroup took down as many details of the lecture as possible. And the last took notes in their normally accustomed manner.

The experiment was conducted in two phases, an im-

mediate and a delayed phase. In the immediate phase, the lecture was presented, the notes from the note-taking groups collected and a comprehension test over the lecture content administered. Data for this phase of the experiment were analyzed using a three dimensional analysis of variance design for the simultaneous analysis of three experimental variables. In addition to the lecture and note-taking method variables, two levels of classes--average and advanced--were introduced as a third variable. The first phase of the experiment was administered to 678 subjects, 318 of whom were used as validation subjects to refine the tests. There remained 120 subjects for each lecture or a total N of 360 scores for the immediate phase analysis.

In the delayed phase, conducted five weeks later, the refined tests were administered as recall tests. The lectures were not repeated. For this phase the advanced classes were not used, and the data were analyzed using a two-factor design. This reduced the number of subjects in the delayed phase to 264.

The general results of this experiment revealed that efficient listening comprehension, under both immediate and delayed recall conditions, was not significantly affected by any of the note-taking methods. Listening comprehension was as effective when subjects were restricted from taking any notes as when subjects employed any of the three methods of note-taking used in this investigation.

Specifically, the following conclusions may be noted:

1. It made no significant difference in listening comprehension in this experiment whether subjects did not take any notes, whether they took notes on only the main points of the lectures, whether they took extensive, detailed notes on the fine factual details of the lectures, or whether they simply took notes in their customary manner.
2. No particular note-taking method proved more efficacious for the advanced subjects than for the average subjects, and vice versa.
3. No particular note-taking group proved superior to the others on the delayed tests.
4. The positive correlation between listening comprehension and intelligence or scholastic aptitude found by Nichols, Heilman, Biggs and other investigators was supported by the results of this study. Advanced classes in this experiment made consistently higher listening comprehension scores than did the average classes.

In view of the findings of this study, then, there would appear to be no justification for defending a restriction prohibiting student note-taking during lectures on the grounds that it interferes with efficient listening. Nor would it appear defensible to advocate any particular note-taking method as being more conducive to effective listening comprehension than any other method. Rather, it would seem that emphasis should be directed toward enhancing the efficiency of the students' customary, habitual note-taking methods consonant with the ultimate use to be made of the notes.

179 pages. \$2.35. Mic 56-2752

A COMPARISON OF THE ABILITY IN FORMAL ORAL COMMUNICATION OF SELECTED LIBERAL ARTS AND ENGINEERING STUDENTS AT THE UNIVERSITY OF PITTSBURGH

(Publication No. 18,334)

Robert Preston Newman, Ph.D.
The University of Connecticut, 1956

One difficult problem in higher education concerns the content of the engineering curriculum. Continuing discoveries in the physical sciences call for increasing technical and scientific offerings, while growing tendencies to place experienced engineers in managerial posts, where communication in non-technical fields is essential, seem to call for more liberal arts courses.

Surveys of opinion about the undergraduate training of engineers made by the University of Pittsburgh, Purdue University, and elsewhere, indicate a belief on the part of businessmen that engineering graduates are deficient in ability in formal oral communication. Individual writers assert that engineers are distinctly inferior to liberal arts graduates in this ability, and that a technical curriculum is to blame.

Two reasons given for the alleged inarticulateness of engineers are that their training in quantitative and mathematical fields does not provide them with a non-technical vocabulary, and that they lack sufficient understanding of the non-technical world to adapt to lay audiences.

In an attempt to explore the hypothesis that liberally-trained individuals are superior in communicative ability to technically-trained individuals, a study was made at the University of Pittsburgh during the years 1954-55. A group of 220 students in the basic speech course, including forty-four liberal arts and thirty-four engineering juniors and seniors, gave a five-minute informative speech to a group of twenty raters as a part of their course requirement. The test speeches were given before unfamiliar audiences, with a week allowed for preparation, and with the entire audience rating the speech.

The training of the two compared groups differed substantially. All the liberal arts students had had a minimum of forty-five hours of liberal arts, while none of the engineering students had had more than eighteen hours of liberal arts. The liberal arts students had elected speech, while the engineering students were taking it as a requirement for graduation.

A one-to-seven-point scale was used for rating general effectiveness, with one representing poor performance, and seven representing good performance. The ratings yielded a reliability coefficient of .87; the mean score of the liberal arts students was 4.45, that of the engineers 4.19. A t-test revealed that this difference is not statistically significant at the five per cent level of confidence.

The possibility was considered that engineers might rate higher than expected because they are a more select group intellectually. A comparison of L-scores on the ACE test was made; the mean stanine score of the liberal arts students was 5.92, that of the engineering students was 5.29. This difference of .63 in favor of the liberal arts students is not statistically significant, but it clearly rules out the possibility that the engineers were a superior group.

The slight superiority of the speech scores made by liberal arts students could be explained by postulating a greater motivation on their part, since they elected to take

speech. It is unlikely that the engineers, who were required to take the course, were as highly motivated.

On the basis of lack of a significant difference in speech scores, and given the probable difference in motivation favoring the liberal arts students, the results of the study do not support the hypothesis that individuals trained in the liberal arts are superior to technically-trained individuals in ability in formal oral communication.

This result suggests either that the common opinion that engineers are inarticulate is false, or that if true, their inarticulateness is not a product of a technical curriculum. No support is found for efforts to increase the liberal content of engineering curricula in order to improve the communicative abilities of engineers.

101 pages. \$1.50. Mic 56-2753

THE RELATIONSHIP OF EXPECTANCY OF STUTTERING TO CERTAIN OTHER DESIGNATED VARIABLES ASSOCIATED WITH STUTTERING

(Publication No. 17,491)

Oliver M. Skalbeck, Ph.D.
State University of Iowa, 1956

Chairman: Professor Wendell Johnson

Some of the variables associated with stuttering which have been investigated in previous studies are the adaptation effect observed when stutterers read or speak the same words successively a number of times, the consistency with which stutterers tend to stutter on the same words, the recovery of the stuttering response when a sufficiently long interval follows adaptation, and the cumulative effect of certain verbal attributes on stuttering. The accuracy and consistency with which stutterers indicate the words on which they expect to stutter have also been studied. The present study examined the relationship of these variables to expectancy of stuttering.

Twenty-five stutterers ranging in age from 14 to 50 years, with an average age of 22 years, indicated the words on which they expected to stutter in a 1000-word passage which they were later going to read. Expectancies of stuttering were indicated at three different times: 1, before reading the passage aloud (pre-adaptation condition); 2, after reading the passage aloud four times (post-adaptation condition); and 3, twenty-four hours later (recovery condition). Single readings of the passage followed the post-adaptation and recovery conditions. The six readings were tape-recorded. The recordings were used for identifying the stuttered words.

The effect of adaptation was observed continuing through reading five. Recovery of stuttering was noted in reading six. There was a significant increase in the number of expectations of stuttering from the pre-adaptation condition to the post-adaptation condition. It was noted, however, that there was a general reduction in the number of expectancies of stuttering from the pre-adaptation to the post-adaptation condition in the group of subjects who reduced their stuttering from reading one to reading four by 50 per cent or more. All but two subjects indicated that they expected to stutter less than they did in their first reading. The mean number of words on which stuttering

was expected in the post-adaptation condition was greater than the mean number of words stuttered in the reading which followed while the reverse was true in the recovery condition, less stuttering being expected than performed. There was an alternating pattern of underestimating and overestimating the stuttering that occurred, with each succeeding estimate of stuttering being closer to the amount of stuttering that occurred. The correlation between expectancy of stuttering and stuttering, which was of a high order even in the initial trial, also became increasingly stronger with each subsequent condition.

The frequency of stuttering on the words on which stuttering was expected was significantly greater than the frequency of stuttering on the words not so indicated. This means that the words on which stuttering was expected were stuttered more consistently than the other words.

The difference between the means of the number of words on which stuttering was expected in the post-adaptation and recovery conditions was not statistically significant, but since the level of expectancy of stuttering was greatly elevated in the post-adaptation condition, one would not expect it to go even higher.

The distribution of the words on which stuttering was expected was such that the largest percentage of them were four-weight words, the next largest percentage, three-weight words, and so on, indicating a positive relationship between word weight and the frequency with which they occur in the distribution of words on which stuttering is expected.

100 pages. \$1.50. Mic 56-2754

A METHODOLOGY RELATED TO THE DETERMINATION OF THE PHASE ANGLE OF BONE-CONDUCTED SPEECH SOUND ENERGY OF STUTTERERS AND NON-STUTTERERS

(Publication No. 17,405)

Courtney Paul Stromsta, Ph.D.
The Ohio State University, 1956

The purposes of the investigation were: (1) to establish the relative phase angles of bone-conducted speech sound energy at the receptors of experimental subjects, and (2) to compare stutterers and non-stutterers with respect to these angles.

The subjects adjusted the amplitude and phase of air-conducted tones to cancel the auditory effect of tones from the same generator that were driven through the superior medial incisors. The amounts of these adjustments were determined for each ear separately for three frequencies, 500, 1,000, and 2,000 c.p.s., and at two sensation levels, 15 and 30 db.

Comparisons of the two groups with regard to the mean phase adjustment of the leading (smaller phase shift) and non-leading air channels indicated significant differences (t, 1 per cent) between the two groups and among the three frequencies: (1) the leading air channels of the groups differed at 2,000 c.p.s.; (2) with non-stutterers, the phase-angle adjustment of 500 c.p.s. differed from the adjustment for 1,000 and 2,000 c.p.s.; and (3) with stutterers, the adjustment for 1,000 and 2,000 c.p.s. differed. A difference in the phase of the bone-conducted sound at the receptors of the stutterers was observed with the 2,000 c.p.s. stimu-

lus. The mean phase adjustments in the non-leading air channels of the two groups were largely consistent with those for the leading channels. The results indicated that the hypothesis that no difference exists between stutterers and non-stutterers with regard to the relative phase angle of bone-conducted sound energy should be rejected.

The two groups were compared with respect to an arbitrary time criterion (0.0001 second), an estimate of the minimum binaural difference to permit the localization of a 100 c.p.s. tone. More stutterers than non-stutterers exceeded the criterion when phase differences between channels were converted to time. Additionally, the leading channels of stutterers were found to be in advance of non-stutterers by 0.0001 second at 2,000 c.p.s. The phase difference between the means of the two air channels at 2,000 c.p.s. for the stutterers, expressed in seconds, was of an order of magnitude that permits sound localization.

On the basis of these results it was postulated that the simultaneous stimulation of the bilateral receptors by in-phase external side-tone and out-of-phase internal side-tone could possibly be preserved in the neural pattern that stimulates the cortical centers and result in out-of-phase action potentials at paired peripheral muscles. A condition existed within the stutterers, at 2,000 c.p.s., comparable to a delay of their external side-tone, a phenomenon which has been demonstrated to disrupt the speech of non-stutterers.

The phase discrepancy may be assumed to increase more for stutterers than for non-stutterers as frequency decreases. The possibility is suggested that less error would be expected near the fundamental frequency of the female voice than with the male voice, and that this factor partially accounts for the sex difference in stuttering.

The results allow the conclusion that leading and non-leading air-channels exist.

An indirect attempt was made to check the reliability of the cancellation method by establishing the phase angle of bone-conducted sound energy from the mid-line of the maxilla to the mastoid on a human skull preparation. The cancellation data were in agreement with the data obtained from the skull. These latter data showed nodal lines of vibration in the region of the auditory receptors. At 2,000 c.p.s. the leading air-channel values for all the stutterers were consistent with the presence of a nodal point anterior to the receptor, whereas those of five of the eight non-stutterers were seemingly related to a nodal point posterior to the receptor. 96 pages. \$1.50. Mic 56-2755

A STUDY OF THE CHANNELS OF COMMUNICATION USED BY ONE HUNDRED NEGROES IN BATON ROUGE, LOUISIANA

(Publication No. 17,454)

Fred Tewell, Ph.D.

Louisiana State University, 1956

Supervisor: Professor Waldo W. Braden

This study is an exploratory investigation of the channels of communication used by 100 Negroes in urban Baton Rouge, Louisiana. This research project sought to discover through personal interview the various media of communication by which the informants obtained their in-

formation. In addition, it sought to discover the frequency of usage and to determine variations of usage at various educational levels. The local media of communication considered include the one Negro and two white newspapers, the one Negro and four white radio stations, the Negro churches, and the Negro social, professional, and service organizations. Other sources include out-of-town radio stations, state and national white and Negro newspapers, and magazines.

The interview schedule, employed to obtain information concerning the various media, was divided into four parts: biographical data, organizational affiliations, information sources, and general information questions. After pertinent biographical information had been obtained, the respondent was asked to name the organizations to which he belonged, to indicate what newspapers, magazines, and books he read, and to list the radio and television stations to which he listened. Some of these oral and written channels were analyzed thematically. The last section of the interview schedule consisted of eight questions about current topics designed to get further information about media used.

The study reveals that the majority of the information carried by the Negro newspapers and magazines falls under two general categories of sensationalism and of ego-building. Through stressing these themes these Negro publications attempt to attract attention, to increase circulation among Negroes, and to promote race pride. Local white radio stations seemed to plan their programs with little or no consideration for the specific interests of the Negro listener; while WXOK, the Negro radio station, attempted to appeal primarily to the Negro listener. The Negro church was one of the most important oral channels of communication since it reached 94 per cent of the Negroes interviewed and it was the only organizational affiliation of the large majority. Nearly all of those who were active in community and professional organizations were from the higher educational categories.

The use of channels of communication varied according to educational level. Those in the lowest educational categories relied almost exclusively on oral channels while those in the highest educational categories used written more than oral channels. The 100 Negroes interviewed seemed to be better informed about subjects which had been emphasized through Negro channels of communication such as Negro newspapers, magazines, and churches.

The evidence shows that information which eventually reached the 100 urban Baton Rouge Negroes passed through many filter points such as ministers, editors, and public speakers, making it virtually impossible for the receivers to get uninterrupted and unshaded messages from the original source. The exclusively Negro channels which carried information of primary importance to these respondents seemed to be more intent in their crusade for the "Negro cause" than in presenting a comprehensive coverage of news events.

The data seems to indicate that if one wanted to get information to the Negroes studied, he would have to employ a combination of channels including radio station WXOK, the State Times (Baton Rouge white daily) and News Leader (Baton Rouge Negro weekly) newspapers, and the Negro churches. Therefore, even though the same message started from the same source and passed along each of these four channels, it is not likely that it would be the same when it reached its destination.

252 pages. \$3.25. Mic 56-2756

COMPARATIVE OSTEOLOGY AND PHYLOGENY
OF THE FAMILY ARDEIDAE

(Publication No. 17,541)

Claude T. Adams, Ph.D.
The University of Florida, 1956

As the present classification of the avian families Ardeidae and Cochleariidae is founded primarily upon external characters and has resulted in the recognition of a large number of monotypic genera, it was thought that a study of the osteology might afford an insight into the phylogenetic relationship of the genera and species of herons.

The study is based upon 326 skeletons, representing twenty-one genera, forty species, and three additional subspecies.

Measurements of the major elements of the skeleton are given. The coefficients of variation are relatively low (averaging 3.85 per cent) compared to those exhibited by other classes of vertebrates. Ratios between skeletal elements also have a low coefficient of variation, averaging 3.25 per cent. Although there is some sexual dimorphism in linear measurements, males being slightly larger, no sexual dimorphism is shown in the ratios constructed from these measurements.

On the basis of differences shown in the conformation and configuration of the various skeletal elements, the interrelationships between the species and genera are traced. The family Ardeidae includes three subfamilies, the Ardeinae or herons, the Cochleariinae or boat-billed heron (heretofore treated as a separate family), and the Botaurinae or bitterns.

The subfamily Ardeinae is divided into four tribes, all of which are new taxons. The tribe Ardeae or typical herons contains the genera *Ardea*, *Hydranassa*, *Butorides*, and *Ardeola*. The tribe Egrettae or egrets includes the genera *Casmerodius*, *Egretta*, *Bubulcus*, and *Florida*. The tribe Nycticoraces or night herons includes the genera *Dichromanassa*, *Pilherodius*, *Syrigma*, *Nyctanassa*, *Gorsachius*, *Nycticorax*, and *Erythrocnus*. The tribe Tigrionithes or tiger bitterns is comprised of the genera *Tigriornis* and *Tigrisoma*. The osteological condition in the subfamilies and tribes is illustrated by photographs.

For each genus the osteological characters are described, and mensural data and ratios are given.

The limits of the monotypic genus *Florida* are extended to include *Leucophoyx*, so that the name of the snowy egret becomes *Florida thula*.

The great white heron is considered a subspecies of the great blue herons, so that the name of the former becomes *Ardea herodias occidentalis*.

The North American green heron is treated as a subspecies of the South American and Old World green-backed heron, under the name *Butorides striatus virens*.

A phylogenetic tree of the various taxons is presented.
193 pages. \$2.55. Mic 56-2757

THE NUTRITION OF THE LARVA
OF THE HOUSE FLY, *MUSCA DOMESTICA* L.
(MUSCIDAE, DIPTERA)

(Publication No. 18,117)

Victor Jack Brookes, Ph.D.
University of Illinois, 1956

A partially defined medium has been developed which will support the growth of the larva of the house fly, *Musca domestica* L. The ingredients of this medium are as follows:

	grams/tube		μgrams/tube
Casein	2.000	Biotin	5.0
Cholesterol	0.020	Choline	2500.0
Salts	0.020	Folic acid	12.5
Lecithin	0.070	Inositol	1250.0
Ribose nucleic acid	0.050	Nicotinic acid	250.0
Adenine	0.0012	Pantothenic acid	125.0
Guanine	0.0012	Pyridoxin	62.5
Uracil	0.0012	Riboflavin	62.5
H ₂ O	7.500	Thiamin	125.0

A fungicide, methyl p-hydroxybenzoate, which had no effect on growth was added to aid in maintaining sterile conditions.

In the absence of ribose nucleic acid (RNA), adenine, guanine, and uracil, growth was very poor. These four components were tested alone and in combinations and it was found that the growth effect was due primarily to the presence of a mixture of adenine and guanine in the diet. Slightly better results were sometimes obtained when all four components were present but these may not be significant.

The larvae required biotin, pantothenic acid, pyridoxin, riboflavin, and thiamin for growth. Choline, inositol, B₁₂, lipoic acid, and carnitine were without effect. Folic acid was an absolute requirement in diets in which RNA, adenine, guanine, and uracil had been omitted.

Other than cholesterol, no lipid requirement was found. Of a variety of fatty acids tested, caprylic, caproic, and myristic acids were found to be inhibitory when added to the diet in concentrations of 14%. Capric acid was toxic at concentrations as low as 3.5%. Lecithin was found to have a slight beneficial effect on growth but this was believed due to its influence on the physical properties of the medium.

Seven of the more commonly occurring carbohydrates were tested but none were found to be beneficial.

A number of proteins were tested by substituting for, or mixing with the casein routinely used in the medium. It was difficult to evaluate the nutritional value of most of these because of the great differences in consistency between them. Of the proteins tested, only soy and a crude material extracted from brain and spinal tissue (Wilson's B Protein) could successfully replace casein. When the level of casein was reduced by 50%, larval growth was curtailed.

In order to prepare a defined medium attempts were

made to substitute protein hydrolysates and amino acid mixtures for the casein. A commercial preparation of enzymatically hydrolysed casein supported a degree of growth at levels of 0.25 to 1.00 grams per tube when supplemented with 0.10 g. of dried brewer's yeast. A more highly purified sample of a casein hydrolysate would not support growth either with or without yeast. The larvae died soon after emergence. The larvae also died on diets in which the nitrogen source was supplied as an amino acid mixture.

Nineteen amino acids were added individually at levels of 10, 25, and 50 mg. of the L-isomers, and 25, 50, and 100 mg. of the racemic mixtures to a basic diet containing casein. With the exception of L-glutamic acid, L-aspartic acid, L-proline, and L-tyrosine, all the amino acids inhibited growth. The inhibition caused by the presence of DL-alanine and DL-phenylalanine was substantially overcome by the presence of 0.10 g. of yeast in these media. Yeast had no effect on inhibition caused by DL-serine and DL-methionine.

The synthetic medium produced fertile flies, the larvae of which grew about as fast and with the same percentage of survival as those grown on a natural medium of fermented alfalfa, bran and brewer's grains. The average weight of larvae grown on a synthetic medium, however, was 30 to 40% less than that of larvae grown on the natural medium. The addition to the synthetic diet of such substances as blood, yeast, and liver improved growth but only slightly.

115 pages. \$1.50. Mic 56-2758

EFFECTS OF CERTAIN ANTIBIOTICS ON EXPERIMENTAL TRICHINOSIS IN MICE

(Publication No. 18,137)

Vincent Gallicchio, Ph.D.
University of Illinois, 1956

Experiments were conducted on albino mice of both sexes (Carworth Farm's CF-1 strain) to determine the effects of various antibiotics on experimental *Trichinella spiralis* infections. A total of 19 different antibiotics was tested, 15 of them, apparently, for the first time. The age range of the mice for all of the experiments was 43 to 91 days at infection. For any given treatment test, the age difference did not exceed 12 days and was usually about 3 days. A total of 444 experimental and control mice was used. Each treatment group consisted of 10 experimental and 10 control mice, with 5 males and 5 females in each subdivision.

Control and experimental mice received a single infective dose of 300 larvae by gavage. All experimental mice, irrespective of the antibiotic being tested, were subjected to the following treatment regimen: each mouse received a single, daily dose of the antibiotic by gavage for 14 consecutive days; treatment was begun approximately 24 hours post-infection. Dosages were based on body weight and were lower than the established Ld_{50} of the antibiotic being tested. On the 30th day following infection, all of the animals were killed and *T. spiralis* larvae were recovered from the musculature. Counts and length measurements of larvae were subjected to statistical analysis.

The numbers of larvae recovered from controls were significantly higher ($P = 0.01$) than those recovered from experimental mice following treatment with 7 antibiotics: filipin, streptomycin sulfate, patulin, endomycin, amice-tin, streptolydigin and U-6591. Lengths of larvae recovered from control mice were significantly shorter ($P = 0.01$) than those from experimental mice after treatment with 8 antibiotics: bacitracin, neomycin sulfate, polymyxin B sulfate, erythromycin, chloramphenicol, Aureomycin HCl, filipin and streptomycin sulfate. At the same level of significance, larvae from mice treated with Terramycin HCl and celesticetin were shorter than those recovered from control mice. Significantly longer larvae ($P = 0.05$) were found in animals treated with endomycin, circulin, patulin and celesticetin. There appeared to be no correlation between reduction in number of larvae and increase or decrease in lengths of larvae. Although significant statistically, the reductions in counts are not clinically significant. Except in those cases where the antibiotic was toxic to the mice, at the dosage level employed, little effect on the weights of experimental mice compared with controls was noted over the 30-day experimental period. Morphological studies of recovered larvae revealed no readily discernible differences between those from control and experimental mice.

Two mice were each infected with 300 larvae recovered from treated mice in each test group in order to determine whether or not the larvae were capable of becoming established in another host. The animals were sacrificed 30 days post-infection and larvae from the musculature recovered and counted. On the basis of the counts and morphological observations, it appeared that the larvae from treated mice had not been affected by the treatments to which their hosts had been subjected.

A review of the literature on the treatment of trichinosis with antibiotic and non-antibiotic substances is included, as well as a review of the literature on the treatment of other helminthiases with antibiotics.

156 pages. \$2.05. Mic 56-2759

ANALYSIS AND HISTORY OF THE OREGON OTTER-TRAWL FISHERY

(Publication No. 17,126)

George Yost Harry, III, Ph.D.
University of Washington, 1956

The objective of the thesis is to present data upon which the management of the Oregon otter-trawl fishery can be based. In addition, a history of the Oregon trawl fishery is presented. A summary of gear development by many of the vessels in the Oregon fleet is presented in table form.

The principal species studied are the English sole (*Parophrys vetulus*), petrale sole (*Eopsetta jordani*), and Dover sole (*Microstomus pacificus*). For these three species the time of spawning, length at maturity, and relation of length to weight are determined. In addition, the number of eggs produced by English and Dover sole at various sizes is calculated.

In 1948 and 1949 a total of 5,648 bottom fish were tagged from otter trawlers operating from Astoria. Almost all of these fish were English, petrale, and Dover sole, and all

but a few were released in the area between Willapa Bay and Tillamook Head. Returns from the tagging give no indication of significant migrations north and south along the coast, but a small amount of exploratory winter fishing resulted in recovery of tagged Dover sole in waters deeper than 200 fathoms. These Dover sole had been tagged during the summer in much shallower water.

The growth of sole of the three species studied is computed from the tag returns.

General comparisons of rates of tag return are made with other tagging experiments of a similar nature along the Pacific Coast.

Otoliths of English, petrale, and Dover sole are used to calculate growth rates and compute age-frequency curves. It is concluded that otoliths are not completely satisfactory for determining the age of these species.

An analysis of the condition of the stocks of English sole, petrale sole, Dover sole, and rockfish is made using the landing records for the period 1942-47, inclusive. The English sole were not completely exploited in 1947. During this period, the petrale sole declined in abundance at least 50 per cent. The Dover sole declined some in abundance, and the condition of the rockfish stocks is obscured because of the several species that enter this category.

English, petrale, and Dover sole were measured at the time commercial landings were made and these data are analyzed for the years 1948-51, inclusive.

In 1950 the catches of Oregon otter trawlers at sea were sampled to get a measure of the amount of discard of both scrap fish and undersized English, petrale, and Dover sole. Approximately 17 per cent of the Dover sole, 33 per cent of the petrale sole, and 27 per cent of the English sole were discarded at sea because they were too small. Approximately one-half of the total catch at sea by weight was discarded.

An analysis is made of the relationship of the mink-raising industry to the otter-trawl fishery. The species composition of the mink food is determined from market samples. An estimate is made of the total amount of fish fed to mink in Oregon in 1949 based on information obtained from questionnaires. The effect of the fishery for mink food on the stocks of fish of the various species is discussed. 347 pages. \$4.45. Mic 56-2760

THE AMBISEXUALITY OF THE RAT OVARY AS REVEALED BY EXPERIMENTS IN PARABIOSIS

(Publication No. 17,472)

Donald Charles Johnson, Ph.D.
State University of Iowa, 1956

Chairman: Professor Emil Witschi

In this study the androgen production by the ovary under conditions of parabiosis is studied in both male and female rats. The direct and indirect effects of estrogen on testes and male sex accessories is investigated by means of ovarian transplantations. Long term Male + Castrate male parabionts were used in testing the effects of continuous androgen stimulation on the accessories.

The ovary implanted into a male united with a castrate female causes an atrophy of the seminal tubules of the

testes. The sex accessories are unaffected, being nearly as large as those of a male united with a castrate male. The ovary in a prostate female united with a castrate, either male or female, produces enough androgen to maximally stimulate the prostate. The ovary implanted at 30 days into a male, castrated at birth, and in union with a similar male produces enough androgen to increase the prostate to about one-third the normal male size. The seminal vesicle is not stimulated. Continuous androgen stimulation of the sex accessories in a male in union with a castrate male causes an enlargement of these organs but no apparent pathology.

The ovary implanted into a male in union with a castrate female does not form corpora lutea. The ovary implanted into a male, castrated since birth, produces corpora lutea. Ovulation was not observed in either case. Ovaries implanted into males united with a castrate female become tumorous after periods of about 25 weeks. Two types of granulosa cell tumors are found. Luteinization of these tumors occurs in older parabionts.

Thecal and interstitial luteinization occurs in ovaries transplanted into male parabiotic twins. This luteinization is believed to be the source of the ovarian androgen.

Ovaries in animals which are in parabiosis with castrates are hormonally bisexual organs, producing both androgen and estrogen. 46 pages. \$1.50. Mic 56-2761

THE EFFECT OF IRRADIATION ON REPRODUCTION BY THE HETEROGENETIC GENERATION OF *STRONGYLOIDES PAPILLOSUS* (WEDL, 1856) RANSOM, 1911

(Publication No. 17,238)

Frank F. Katz, Ph.D.
University of Pennsylvania, 1956

Supervisor: Dr. George L. Graham

The theory of triploidy in *Strongyloides papillosus* has been investigated by subjecting free-living males and females to chemical and physical agents in an attempt to produce by gynogenesis and/or androgenesis a second, hitherto unknown, free-living generation.

Worms in petri dish rabbit coprocultures were isolated by conventional Baermann procedures. The nematodes under observation were cultured *in vitro* under non-sterile conditions, the best cultures being obtained in open depression slides with a fecal extract-nutrient agar medium diluted one-half with distilled water and adjusted to pH 7.

Although some observations were made using methylene blue, toluidine blue, and x-rays, the major work involved cobalt-60 gamma irradiation. Worms were placed in plastic tubes, stoppered, and lowered into the cobalt source. The individual forms were separated after irradiation.

Results have been analyzed on the basis of number of larvae per bisexual pair or gravid female, single series experiments, multiple series experiments where individual series were combined for observing results at particular doses, hatching, survival, lethal and dominant lethal effects, and the number of "hits" involved in survival effects in relation to the target theory. The following observations and conclusions have been made:

1. Worms in an aqueous solution of toluidine blue are killed when exposed to unfiltered artificial light.
2. Daily variations in the production of larvae may occur in bisexual and gravid female irradiated and control cultures, but definite effects of irradiation are evident.
3. Fewer offspring are produced in bisexual cultures containing irradiated males of the fourth and fifth stage than in bisexual cultures of irradiated third or fourth stage females.
4. The average number of active larvae per gravid female of the single or multiple series is less for the irradiated than for the control.
5. In multiple series, the average number of active larvae is less in irradiated male cultures than in the controls beginning at 15 kr and in irradiated female cultures beginning at 35 kr; reproduction can still take place at 42 kr in the former and 50 kr in the latter.
6. In multiple series controls, if a larval count of one day is higher than that of another day, it is not necessarily accompanied by an increase in larval production by irradiated worms.
7. No reproduction took place in the bisexual cultures single series at 40 kr and subsequent doses.
8. In the single series, the results of irradiating gravid females at 5 kr and of immature females of bisexual cultures at 20 kr are, apparently, not different from the controls while doses greater than these show a distinct adverse effect upon reproduction.
9. With increased doses of irradiation there is a decrease in the percentage of eggs hatching and survival of larvae.
10. The production of lethals and dominant lethals increases with increased dosage so that at 20 kr in gravid females and 40 kr in bisexuals 100 percent killing effects occur.
11. The number of "hits" (ionizations) necessary to produce these effects are less for males (approximately 6) than for immature females (much greater than 10) or gravid females (approximately 35).
12. Doses of approximately 20 and 40 kr are critical for *S. papillosus* and, probably, other nematodes.
13. Various cells and developmental stages differ in their radiosensitivity. Cleavage rate and embryogenesis are delayed and spermatozoa are still active at 5 hours after 20 kr exposure.
14. Irradiation at the doses used does not prevent immature females from completing their development.
15. No conclusions can be made concerning the effect of irradiation on adults.
16. *S. papillosus* appears to be more radio-resistant than *Trichinella* and *Rhabditis pellio*.

173 pages. \$2.30. Mic 56-2762

EVOLUTION OF THE HIGHER CATEGORIES
OF CERCOPIDAE, WITH A REVISION
OF THE NORTH AMERICAN SPECIES
OF *APHROPHORA* (HOMOPTERA)

(Publication No. 18,175)

Thomas Edwin Moore, Ph.D.
University of Illinois, 1956

The purpose of this dissertation is to orient the

spittlebug family Cercopidae and its subfamilies phylogenetically in relation to other Homoptera, to delineate species groups in the genus *Aphrophora*, and to present a revision of the North American species of *Aphrophora*.

This study is the first one dealing with spittlebugs and their relationships to include morphology of immature stages in the analyses. Diagrams presenting deduced phylogenetic relationships for the Auchenorrhyncha and the subfamilies of Cercopidae are presented. The primary characteristics upon which these phylogenetic conclusions are based are the structure of the male genitalia, of hemelytra, of antennae, and of the abdomen in nymphs. No fossil material was examined in preparation for the dissertation.

It is proposed that the Cicadellidae and Membracidae likely had a very close common ancestry and that the following events probably took place. From a form closely related to the common ancestor of the above two families arose the Fulgoridae, Cicadidae, and Cercopidae. Of these latter three families the Fulgoridae appear to be an early and subsequently highly specialized line, while the Cercopidae and Cicadidae seem closely related and of later common origin based primarily on great similarity in the structure of the abdomen and antennae among nymphs of the two families.

It is further suggested that within the family Cercopidae four major lines of specialization occurred, represented by the subfamilies Aphrophorinae, Cercopinae, Clastopterinae, and Machaerotinae. From a common familial ancestor there likely arose 1) a form possessing large hemelytral membranes in adults, only one row of terminal metatibial spines in both adults and nymphs, an elongated ninth abdominal segment in nymphs, and hypersegmentation of the region past the sixth antennal segment in nymphs, and 2) a second form possessing reduced hemelytral membranes in adults, more than one row of terminal metatibial spines in adults and nymphs, and normal antennae and ninth abdominal segments in nymphs. The Clastopterinae, including only the genera *Clastoptera* and *Sepullia*, and the Machaerotinae probably arose from a common ancestor such as described for 1) above, while the Aphrophorinae and Cercopinae likely both arose from a form similar to 2). As a result of this analysis *Sepullia* is transferred from the Aphrophorinae to the Clastopterinae and *Neaenus* is transferred from the Aphrophorinae to the Cercopinae.

The genus *Aphrophora* Germar was found to contain eight species groups defined primarily on the basis of the structure of the aedeagus and basal piece. These groups are the *alni* group, the *annulata* group, the *burmanica* group, the *canadensis* group, the *durangensis* group, the *irrorata* group, the *quadrinotata* group, and the *salicis* group. Thirty-four of the one hundred five species referred to the genus were available for examination.

A revision of the North American *Aphrophora* fauna is presented in which *A. detritus* (Walker) is proposed as a synonym of *A. saratogensis* (Fitch) and *A. fulva* Doering and *A. maculosa* Doering are shown to be synonyms of *A. permutata* Uhler. *Aphrophora alni* and three species new to science are added to the known North American fauna, bringing the total for this genus to eighteen species. A key to species for males and illustrations of male genitalia for each species are given.

Structural variation in *A. princeps* and in *A. permutata* is discussed and treated in detail for the latter species.

It is shown that there is insufficient evidence of geographical segregation of variants in *A. permutata* to recognize subspecies in spite of the fact that some of the variants are quite striking. 96 pages. \$1.50. Mic 56-2763

**ENDOCRINE ROLE OF RAT PLACENTA
AS REVEALED BY EXPERIMENTS IN PARABIOSIS**

(Publication No. 17,477)

Saylo Munemitsu, Ph.D.
State University of Iowa, 1956

Chairman: Professor Emil Witschi

The endocrine role of the rat placenta was studied by experiments of parabiosis. Female rats were united at approximately thirty days of age and were placed with males after reaching sexual maturity. The pseudopregnancy that occurs in a rat united to a pregnant animal results from the transmission of a luteotrophic hormone across the parabiotic connection. Several observations indicate that this luteotrophic factor is of placental origin and that it appears as early as the fifth day of pregnancy. By midterm it can independently maintain the corpora lutea. The ovulation records of Castrate female - Pregnant female pairs indicate that the placental luteotrophic factor has no ovulation - inducing action. It is in this way different from hypophyseal LH, human chorionic gonadotrophin and pregnant mare serum.

FSH transmission from a castrate hypophysis terminates a contralateral pregnancy if the gonadotrophic influence is exerted before the thirteenth day. Later exposure to excessive FSH does not influence the pregnancy. In the latter case, the pregnancy ovaries are hyperstimulated and extensive follicular development occurs. Following parturition, an animal that has been in parabiotic union with a castrate superovulates. Many eggs are abnormal. If the ovariectomized animal is also pregnant, the contralateral pregnancy continues even though the operation is performed as early as the eighth day. This observation and supporting data indicate that viable rat placentae suppress FSH release by the castrate hypophysis. This may indicate estrogen secretion by the rat placenta. In several instances, progestational effects continue in pregnant parabiotic rats during the period post-castration when viable placentae are retained in utero. This confirms previous reports of progesterone secretion by the rat placenta. However, under the conditions employed in these experiments, neither estrogen nor progesterone crosses the parabiotic connection in sufficient quantity to become recognizable.

The combined observations indicate that the rat placenta starts early in gestation to produce a luteotrophic hormone. It produces as well both estrogen and progesterone, but of insufficient quantity for the autonomous maintenance of pregnancy. 41 pages. \$1.50. Mic 56-2764

STUDIES ON CILIATES FROM MOLLUSKS OF IOWA

(Publication No. 17,480)

James Hubert Penn, Ph.D.
State University of Iowa, 1956

Chairman: Professor R. L. King

A study has been made of the ciliate fauna of nine species of mollusks: seven were found to harbor endozoic or ectozoic organisms. Material from the mantle cavity of mussels, and body slime of snails was fixed in Schaudinn's fluid and stained in Mayer's haemalum, or impregnated with silver. The silver impregnation method used was Corliss' modification of the Chatton-Lwoff technic.

Two species of ciliates, which belong to the family Conchophthiriidae are reported: (1) *Conchophthirius curtus* Englemann, from the gills and mantle cavity of *Lampsilis siliquoidea* Barnes and *Anodonta grandis* (Say), and (2) *Myxophyllum steenstrupi* (Stein), from the slime of the following terrestrial snails: *Anguispira alternata* (Say), *Triodopsis multilineata* (Say), and *Oxyloma decampi* Gouldi Pilsbry.

In northwestern Iowa, *C. curtus* appears to be limited to mussels and *M. steenstrupi* to terrestrial snails. The chief structural differences between the two species is the position and structure of the mouth, and the number of macronuclei. The fibrillar system, the contractile vacuoles, and reproductive activities of both ciliates are described.

Two species of aquatic snails: *Physa gyrina* (Say) and *Helisoma trivolvis* (Say) harbored *Trichodina* sp. as an ectozoic commensal. No ciliates were found in the snails, *Lymnaea palustris* (Müller) and *Zonitoides arboreus* (Say). 46 pages. \$1.50. Mic 56-2765

**POPULATION CHANGES IN THE CAECAL
PROTOZOA OF RATS AND SOME FACTORS
INFLUENCING THEM**

(Publication No. 17,260)

Wesley J. Peterson, Ph.D.
University of Pennsylvania, 1956

Supervisor: D. H. Wenrich

Twenty white, male rats of the same age and breed and kept on a standard balanced diet, were studied to ascertain what variability could exist in the protozoan population: a) between rats in the group, b) between various regions of the caecum in the entire group, and c) between various regions of the caecum in individual hosts. Within the group of rats, significant difference in population size was found for *Trichomonas hominis*, *T. minuta* and *Chilomastix bettencourti*. *Trichomonas muris* was found not to differ significantly. No region of the caecum was found to contain a significantly higher population size than any other region for the four species of protozoa analyzed. Among regions of the caeca of individual rats, however, very great differences were observed to exist in the uniformity of distribution of the various species present.

For the first time, a time-series analysis was made of the caecal protozoan populations of a rat. Examinations were made every four hours on five rats for 100 points in time and the findings are given. On the basis of the variables measured, a simple additive regression hypothesis was formulated to account for the variability in population size exhibited by individual species over the survey period. The variables used were: dependent population at some previous time, the size of two other protozoan populations, plus water and food intake at some previous time. The proportion of variability accounted for by the regression differed from species to species and rat to rat, the lowest being approximately 35% and the highest 96%.

56 pages. \$1.50. Mic 56-2766

**CONTROL OF THE SIX-SPOTTED LEAFHOPPER,
Macrostes fascifrons (Stal), A VECTOR OF
LETTUCE-YELLOWS VIRUS**

(Publication No. 18,289)

Rudolph Greer Strong, Ph.D.
Cornell University, 1956

Lettuce-yellows, a disease caused by the aster-yellow virus, has been considered the limiting factor of lettuce production in New York. The six-spotted leafhopper, *Macrostes fascifrons* (Stal), provides the only way for the spread of the eastern strain of the virus in lettuce.

Studies were made on leafhopper control and experimental techniques to evaluate insecticides for yellows prevention. Rearing methods were developed to supply most of the 34,000 adult six-spotted leafhoppers used in experiments.

Transmission experiments on aster-yellows virus showed that infected China asters made good virus source plants for leafhopper infection feeding, but the periwinkle (*Vinca rosea*) did not. After 18 days' incubation period of the virus, no differences were found in infectivity of viruliferous leafhoppers with infection feeding periods of 3, 6, and 10 days on asters. With 18 days' virus incubation, 2 viruliferous insects per plant were as successful as larger numbers in inoculating 100 per cent of healthy plants. Infective insects resting on plants for 10 minutes inoculated as readily as those caged on plants for 6 hours, but not so frequently as those on plant for 24 hours. Most infective leafhoppers inoculated only 1 plant per 24-hour period of individual confinement to groups of plants. About 2/3 to 3/4 of viruliferous leafhoppers, after becoming infective, inoculated all plants on which they were confined individually for 12-48 hours in a series of serial transfers, but such consistent infection was not obtained with 1-hour confinement periods. Five commonly grown varieties of lettuce and 1 variety of China aster were equally susceptible to aster-yellows virus infection.

DDT, malathion, parathion, and Systox insecticide sprays were tested for leafhopper control and yellows prevention. Small plot experiments failed to differentiate effectiveness among treatments. Insignificant differences in incidence of yellows between sprayed and unsprayed plots were considered due to migrating leafhoppers from checks and adjoining areas quickly reinfesting sprayed plots. A large plot experiment was not entirely satisfac-

tory for this purpose either, presumably due to a small proportion of infective leafhoppers in the population.

The need for better control over infective leafhopper populations led to an experimental procedure where small areas of lettuce were caged and infested with viruliferous insects. Differences were found between insecticides when lettuce was exposed to viruliferous leafhoppers within 2 hours after spraying. More pronounced differences were found between treatments where lettuce plants were exposed to 2 viruliferous insects per plant. Insecticides had little effect 3 days after spraying.

Time-mortality studies were made to supplement field experiments. When leafhoppers were caged over plants within 2 hours after spraying, differences were obtained between insecticides in insect mortality at various time intervals after confining insects on plants. Little mortality resulted when insects were placed on plants 3 days after spraying.

Four rates of each of the four insecticides were compared. The time required to kill 90 per cent of leafhoppers appeared to be an inherent characteristic of an insecticide and increasing the dosage level above the minimum for 90 per cent mortality had little effect in this respect. According to the time required to obtain 90 per cent mortality of leafhoppers, the insecticides are ranked in the order of malathion, parathion, Systox, and DDT.

It is generally concluded that the insecticide sprays will control leafhoppers but will not prevent inoculation of some plants by infective insects. Insecticides for six-spotted leafhopper control reduce the incidence of lettuce-yellows in fields by killing leafhoppers before they become infective and in terminating the infection potential of infective leafhoppers. 131 pages. \$1.75. Mic 56-2767

**THE SYSTEMATICS AND ECOLOGY OF THE
Sternotherus carinatus COMPLEX
(TESTUDINATA: CHELYDRIDAE)**

(Publication No. 17,019)

Donald Ward Tinkle, Ph.D.
Tulane University, 1956

The *Sternotherus carinatus* complex of three species (four forms) is limited primarily to the Gulf coastal plain and has presumably speciated in this area. The present study compares the external morphology, the skull, and the ecology of these species to establish the relationships within the group. The pattern of species distribution is compared with that in other turtle genera on the Gulf coast.

Samples of *Sternotherus* were collected from most major rivers of the Gulf coast, and were supplemented by material in many museum collections. The samples from each river drainage are treated separately to show small differences between populations.

The examination of stomachs, intestines and gonads furnished information on food habits and reproduction. Counts of rings in the shields of the carapace and plastron furnished a basis for estimates of age and growth.

Many observations and experiments in the field and laboratory provided information on habits and behavior.

Geographic, sexual, ontogenetic or uncorrelated vari-

ability exist in each species. Significant differences in certain characters are apparent between populations of the same species in different rivers. Some characters show clear east to west trends, while others display the same or fluctuating means between populations in different rivers. Some characters used by previous authors to distinguish between species are not diagnostic. Other characters are suggested for use in determining species in this complex.

Great variability exists in the skulls, but in general the study of the skull reinforces the ideas of relationships obtained from external characters. The suggested phylogeny of the genus places *S. odoratus* as the oldest form, with *m. minor* and *m. peltifer* evolving from the same progenitor. *Sternotherus carinatus* arose from pre-*peltifer* stock. *Sternotherus depressus* is most closely related to *m. peltifer*, but the path of its differentiation is not clear, nor is the reason for its extreme isolation. The youth of most Gulf coast rivers and the obvious similarities between members of the *S. carinatus* complex suggest that most of their evolution occurred during the late Pliocene and Pleistocene.

The patterns of species distribution in The *Sternotherus carinatus* complex, in the *Trionyx ferox* and *T. muticus* groups, in *Pseudemys* and in the broad-headed *Graptemys* are grossly similar and may indicate similar rates of evolution. The pattern in the *Graptemys oculifera*

group is one of extreme differentiation in youthful rivers, indicating a more rapid rate of evolution.

The growth curves of all *Sternotherus* are similar; growth rate is fastest in *S. carinatus*.

Sex ratios are not markedly divergent except in *S. depressus*, but in this species chance selection of individuals may account for the divergence.

Sexual maturity is generally reached by all forms at a size of 75-100 mm (carapace length) and at four to six years of age. The sexes and species show slight differences in age and size at maturity.

The average annual egg production per female is five to seven. Some individuals have a higher potential (highest, 17) and may deliver more than one brood per year.

The juveniles of the *S. carinatus* complex are mainly insectivorous; older individuals and adults become mollusc feeders. Feeding habits vary slightly geographically. Feeding occurs early in the morning, late evening or at night; turtles are inactive during the day. In captivity, *S. m. peltifer* is the most aggressive feeder, *S. depressus* the least.

All members of the group are associated with streams, rivers, or bodies of water associated with these lotic environments. In these areas, they occur most abundantly with *Trionyx*, *Pseudemys* and *Graptemys*.

The habit of basking has been reported in several *Sternotherus*, but is apparently well-developed only in *S. carinatus*.

274 pages. \$3.55. Mic 56-2768

AUTHOR INDEX

- ABOUDI, Reuben William. Distributions and their Laplace transforms. XVI, 1649
- ADAMS, Claude T. Comparative osteology and phylogeny of the family Ardeidae. XVI, 1740
- ADAMS, Donald Kendrick. Education in Korea 1945-1955. XVI, 1630
- ADAMSKY, Robert Francis. The crystal structure of pentanamide. XVI, 1591
- ADAM, Angelos Vasilios. The role of amino acids and certain other metabolic agents on the toxicity of copper sulfate to spores of *Stemphylium sarcinaeforme* (Cav.) Wilts and *Monilinia fruticola* (Winter) Honey. XVI, 1549
- ADLER, Howard Irving. Objective techniques in bacterial nuclear cytology. XVI, 1557
- ALLEN, Richard Eilers. Charles Kingsley and the Industrial Revolution. XVI, 1680
- ALEXANDER, Edward L. Radiation chemistry studies on ferrous, ceric, dichromate and permanganate solutions with high intensity x-radiation. XVI, 1591
- ANDERSON, Lee William. Topological lattices. XVI, 1690
- ARBINGAST, Stanley Alan. A geographic study of the pattern of manufacturing in Texas. XVI, 1657
- BACHMAN, Joseph William. Responsibility of corporate financial management as to capital impairment under price level changes. XVI, 1608
- BAECKER, Anne Frances. The treatment of history in the works of Gertrud von le Fort. XVI, 1680
- BAGLEY, Norton Russell. Some factors affecting the occupational choices of sixth and eighth grade rural boys. XVI, 1638
- BALLANCE, Richard Solomon. Cauchy type representations for functions of a complex variable. XVI, 1690
- BALMER, Donald Gordon. Interest groups in action: a case study of Oregon milk control, 1933-1954. XVI, 1713
- BANNON, Charles Joseph. An evaluation of physics and chemistry instruction in Connecticut public secondary schools. XVI, 1635
- BEATY, Earl Claude. Measurement of the temperature dependence of the mobilities of positive ions in gases. XVI, 1699
- BEERS, Russell James. Effect of moisture level on germination of bacterial endospores. XVI, 1558
- BELT, Roger Francis. The crystal structures of hydroxylamine-O-sulfonic acid and potassium hydroxylamine-N-sulfonate. XVI, 1592
- BELTZ, LeRoy Duane. Preparation of p-thymotinic acid and some of its derivatives. XVI, 1590
- BETHLAHMY, Nedavia. A contribution to the study of soils by means of electrical resistivity apparatus. XVI, 1543
- BHARNURATNA, Sai. Application of a theory of communication to problems of supervision of primary extension schools of Thailand. XVI, 1639
- BLECHA, Milo Kasel. A study of procedures used in the selection and retention of superintendents in fifty selected small schools. XVI, 1621
- BLOCK, William Joseph. The separation of the Farm Bureau and the Extension Service as a political issue. XVI, 1713
- BLUMENTHAL, Robert McCallum. An extended Markov property. XVI, 1690
- BODEMER, Charles William. The origin and development of the extrinsic ocular muscles in the trout (*Salmo trutta*) and the gar pike (*Lepidosteus osseus*). XVI, 1553
- BOGDEN, Arthur E. Serologic characterization of an ethanol extractable substance peculiar to rat neoplasms related to certain natural hemagglutinins present in the normal rat. XVI, 1563
- BOHL, Robert Walter. Determination of heterogeneous equilibrium from electromotive force measurements. XVI, 1655
- BOK, Frank Joseph. Evaluation of improvement in gait of cerebral-palsied children. XVI, 1631
- BOLDT, Albert Walter. The honorary leadership fraternity in American society: a survey analysis of Florida Blue Key members and nonmembers. XVI, 1613
- BOYER, Mark Allen. A study of teacher participation in policy making in St. Louis County. XVI, 1614
- BRASHER, Thomas Lowber. "To all the people of Brooklyn": Whitman as editor of *The Brooklyn Eagle*, 1846-1848. XVI, 1681
- BRAUN, William K. The introduction of representative institutions into Malaya. XVI, 1714
- BREWSTER, Laurence Walter. An exploratory study of some aspects of critical listening among college freshmen. XVI, 1735
- BREY, Mary Louise Van Natta. The preparation and properties of vinyl and glycidyl fluoroethers. XVI, 1580
- BRICE, Marshall Moore. A comparison of subjective predictions with objective predictions of college achievement. XVI, 1622
- BRODERICK, Carlfred Bartholomew. Predicting friendship behavior: a study of the determinants of friendship selection and maintenance in a college population. XVI, 1732
- BROMS, Bengt Baltzar. Ultimate strength of long reinforced concrete columns. XVI, 1654
- BROSE, Olive J. The survival of the Church of England as by law established—1828-1860. XVI, 1669
- BRONS, Kenneth Allyn. Groups, all of whose partial endomorphisms are extendable. XVI, 1691
- BROOKES, Victor Jack. The nutrition of the larva of the house fly, *Musca domestica* L. (Muscidae, Diptera). XVI, 1740
- BROWN, Ernest Evan. An appraisal of and recommendations for increasing the degree of competition in Florida's dairy industry. XVI, 1543
- BRYAN, Robert Sedgwick. A defense of the possibility of objective aesthetics. XVI, 1697
- BRYANT, Ernest A. Electric conduction in an oil-pumped vacuum system. XVI, 1705
- BRYSON, Elizabeth Agnes Emily. Contributions to the study of the Thoman recension of Aeschylus. XVI, 1677
- BUCK, Robert John. Middle Helladic Mattpainted pottery. XVI, 1668
- BUXTON, Doris Patterson. A study of muscular fitness of Iowa children ages six through fifteen. XVI, 1632
- BUZZOTTA, V. Ralph. Association-probability in the study of verbal behavior. XVI, 1722
- CALDWELL, Warren Wendell. The archeology of Wakemap: a stratified site near the Dalles of the Columbia. XVI, 1668
- CAMPBELL, Ada Marie. Effect of granule size, citric acid and sucrose on properties of pastes and gels of wheat starch. XVI, 1672
- CANNON, Emerson Taylor. A study of the flaring and ablation associated with ultra-speed pellets. XVI, 1699
- CANTWELL, Robert Murray. Internal bremsstrahlung in the capture of μ^- mesons by nuclei. XVI, 1706
- CARSON, Deane Chalmers. Federal Reserve support of Treasury refunding operations. XVI, 1609
- CASELLA, Russell Carl. The halogen band in sodium chloride. XVI, 1711
- CHAMBERLAIN, Mark Munroe. The structures and stabilities of some complex inorganic compounds. I. The determination of water in complex inorganic compounds. II. The structures of some thiocyanato cobalt amines. XVI, 1576
- CHAMPAGNE, Francis Cyprien. An analysis of the Bureau of Youth Services in the Connecticut State Department of Education and the extent to which its leadership services are used by the secondary schools of Connecticut. XVI, 1615
- CHANG, Suk Chul. Microscopic properties of whole mounts and sections of human bronchial epithelium of smokers and nonsmokers. XVI, 1554
- CHEN, Kuo Chung. A study of the mechanisms and functioning of manpower planning. XVI, 1602
- CHODAKOWSKI, Alexander Stanley. Electric and magnetic properties of some alkaline earth titanates. XVI, 1650
- CHRYSSAFOPOULOS, Nicholas. A correlation of pedologic soil types with rigid pavement performance in Dewitt County, Illinois. XVI, 1648
- CLUETT, Maxwell Lewis. A spectrophotometric method for the determination of submicrogram amounts of nickel in human blood. XVI, 1570
- COCHRANE, James Ely. An analysis of the transition from high school to college in English composition in selected New York State schools. XVI, 1639
- COHEN, Robert Solomon. A radio-echo study of atmospheric turbulence in the lower ionosphere. XVI, 1700
- COLE, Leslie John Norman. Chromatographic procedures for the isolation of the original constituents of natural waxes, with special reference to the study of ouricuri wax. XVI, 1570
- COLEMAN, Robert Vincent. Studies of crystal growth and dislocations. XVI, 1706
- CORDER, Arthur R. The removal of carbon from ferro-chromium. XVI, 1577
- COTTLE, Merva Kathryn. Studies of thyroid gland function in rats exposed to cold. XVI, 1711
- COUGHANOWR, Donald Ray. Oxidation of sulfur dioxide in fog droplets. XVI, 1647
- COX, Robert George. Development and evaluation of methods of measuring net income in independent retail drug stores at the department and commodity group levels. XVI, 1609
- CURTIS, Richard Bertram. Meson production by electrons in hydrogen. XVI, 1706
- DALE, James Lowell. Tobacco mosaic virus infection of bean as influenced by leaf treatments. XVI, 1566
- DASHOWITZ, Barry Harold. A study of some butyl and isopropyl esters in thixotropic systems. XVI, 1666
- DAVENPORT, John Warner. Choice behavior as a function of drive strength and rate of learning. XVI, 1723

- DAVIS, Edward Lyon. Variation in cultivated varieties of *Humulus lupulus*, and its relation to the possible sources of these varieties. XVI, 1566
- DAVIS, Harold Edmund. Method and form in the novels of Joseph Conrad. XVI, 1682
- DAVIS, Velmar Walk. Economics of field shelling and artificial drying of corn in Illinois. XVI, 1544
- DAVISON, Walter Francis. Mosaics. XVI, 1692
- DECK, Charles Francis. The kinetics of the ferricyanide-ferrocyanide exchange reaction. XVI, 1578
- DECKER, Freeman Bernard. The development of the Nebraska common school lands and funds. XVI, 1622
- de GRUMMOND, Lena Young. The status of the retired white teachers of Louisiana. XVI, 1615
- DeKOCK, Henry C. The multiple county approach to school district reorganization in Iowa. XVI, 1616
- DILWORTH, John Richard. The use of aerial photographs in cruising second-growth Douglas-fir stands. XVI, 1549
- DOERPINGHAUS, Sigmund Leonard. Studies on the effect of RNA and xanthine on roots of inbred and hybrid tomatoes *in vitro*. XVI, 1567
- DRESHER, William Henry. A kinetic study of the leaching of molybdenite. XVI, 1656
- DUDEK, Richard Albert. The application of mathematical techniques in the field of industrial engineering. XVI, 1645
- DUFKE, Edward James. Part A: the pyrolysis of 9-arylidene- and 9-alkyldenefluorenes and Part B: the acid catalyzed reaction of 9-fluoreneol with 9-alkyldenefluorenes. XVI, 1581
- DUFF, McGee A. A study of color reactions in non-aqueous media. XVI, 1578
- DUNN, Floyd. Determination of ultrasonic dosage relations for the mammalian central nervous system. XVI, 1650
- DUPUY, Harold Paul. Studies in experimental lathyrism. XVI, 1571
- DUSENBERRY, James Elwood. Lipogenesis in submerged grown *Claviceps purpurea* and investigation of the unsaponifiable matter. XVI, 1666
- DUTTON, John D. Ethical and legal theory in the United States: a comparative study. XVI, 1698
- EATON, Richard Channon. Effects of certain steroid hormones on growth and feed efficiency in chickens. XVI, 1547
- EINGOLD, Bernard. Problem-solving by mature rats as conditioned by the length, and age at imposition, of earlier free-environmental experience. XVI, 1723
- EINSTMAN, Robert Vincent. The relative efficiencies of the isomeric butenes in the removal of free methyl radicals. XVI, 1593
- ELGERD, Olle Ingemar. Capacitor switching phenomena in networks containing long transmission lines. XVI, 1651
- ELSON JR., Benjamin Franklin. Sierra Popoloca morphology. XVI, 1678
- EPSTEIN, Bart Jacob. The Quincy food market: a study in marketing geography. XVI, 1658
- ESPLIN, Alma Lamar. A study of some effects of pelleting a ground mixed ration on feed utilization by growing-fattening lambs. XVI, 1547
- EUGERE, Edward Joseph. Studies of the antimicrobial properties of ion exchange resins. XVI, 1697
- EVANS, William George. A study of the flight habits of the European chafer, *Amphimallon majalis* Razoumowsky (Scarabaeidae). XVI, 1564
- FAIRBANKS, JR., Alonzo James. The effects of X-rays on the biosynthesis of tobacco mosaic virus. XVI, 1712
- FEND, Alvin Vincent. Unbiased estimation and admissibility and the treatment of ties in the sign test. XVI, 1692
- FERGUSON, William Sidney. Chronopotentiometric analysis in fused lithium chloride-potassium chloride. XVI, 1593
- FERREN, Richard A. Catalysis in the hydrazinolysis of ethyl acetate. A determination of the velocity constants, energies of activation and entropies of activation for the reaction. XVI, 1581
- FERRER, Adina Rigor. Procedures for reconstructing the course of study in physical education for elementary schools in the Philippines. XVI, 1632
- FLYNN, Luther. A study of moral, spiritual, and religious values in the public schools of Virginia. XVI, 1617
- FOGGIO, Richard Dominic. Nuclear substituted analogs of pharmacodynamically active phenethylamines and isoquinoline. XVI, 1582
- FOOTE, Nelson Northrup. The professionalization of labor in Detroit. XVI, 1732
- FOSSLAND, Robert Gerard. A histological study of the postnatal bovine testis (*Bos (Taurus) typicus*). XVI, 1554
- FOSTER, George. The acyloin reaction of esters of dibasic aliphatic acids in liquid ammonia. XVI, 1582
- FRANKLIN, Jerrold. Pion production in pion-nucleon scattering. XVI, 1706
- FREED, Aubyn. On the ergodic theorem in dynamical systems with variant measure. XVI, 1693
- FREEMAN, Thomas Edward. Studies on the control of pink root of shallot. XVI, 1567
- FREITAG, Melvin. A test of primary stimulus generalization by the single-stimulus training technique. XVI, 1724
- GALLICCHIO, Vincent. Effects of certain antibiotics on experimental trichinosis in mice. XVI, 1741
- GIBBS, Hugh Harper. The effect of substituents on the 4-position on the stability of 1-amino-2-methylnaphthalene derivatives. XVI, 1582
- GOLD, Richard Robert. On superposability and self-superposability conditions for hydrodynamic equations based on continuum. XVI, 1646
- GOLDEN, Beverly. A comparison of the distractibility of intellectually normal and mentally retarded subjects. XVI, 1718
- GOLDHAMMER, Paul. Topics in nuclear structure. XVI, 1707
- GOLDSMITH, Virginia Grace. An analysis of the nature and status of action research in education. XVI, 1640
- GRAY, Betty Sue. Theoretical studies on the chemistry of quaternary ammonium compounds. XVI, 1583
- GREGG, Robert Whitcomb. The United Nations and the limitation of opium production. XVI, 1716
- GRIFFIN, Beverly Smith. Synthesis of glucose phosphonate derivatives. XVI, 1583
- GRIFFING, David Francis. Nuclear orientation of cobalt isotopes. XVI, 1707
- GRUBB, Patti Murray. A psychophysical study of vowel formants. XVI, 1736
- GUSHEE, Beatrice Eleanor. Correlation of composition and structure of some perovskite-like compounds of transition metals. XVI, 1578
- GUSTAFSON, John Milton. A study relating to the boy's changing voice: its incidence, training, and function in choral music. XVI, 1696
- GUSTAFSON, Winthrop Adolph. On multiplicity theorems and an exact solution in diabatic flow. XVI, 1646
- HALL, Harold Dale. Relationships of selected characteristics of organization to practices in school systems: an exploratory measure of the extent of diffusion of administrative procedures and staffing practices and their relationships to selected characteristics of school systems. XVI, 1623
- HALL, Larry Cully. Square wave titrimetry. XVI, 1593
- HALSEY, JR., Van Rensselaer. The portrait of the businessman in twentieth century American fiction. XVI, 1682
- HAMBACHER, William O. An experimental investigation of whiteness constancy with suggestions for an explanatory approach. XVI, 1724
- HANCOCK, Robert Spencer. An examination of William Fellner's oligopoly theory. XVI, 1611
- HANSON, Robert J. A study of college admission counseling in Michigan. XVI, 1641
- HANSON, Roger James. A fast-particle counter utilizing Cerenkov radiation from a gaseous dielectric. XVI, 1708
- HARPER, JR., Robert C. An investigation of the compressibility factors of gaseous mixtures of carbon dioxide and helium. XVI, 1594
- HARRISON, Walter Ashley. Scattering of electrons by lattice vibrations in crystals. XVI, 1700
- HARRY, III, George Yost. Analysis and history of the Oregon otter-trawl fishery. XVI, 1741
- HAY, William Walter. The effects of weather upon railroad operation, maintenance, and construction. XVI, 1649
- HAYFLICK, Leonard. The growth of human and poultry pleuropneumonia-like organisms in tissue cultures and in ovo and the characterization of an infectious agent causing tendovaginitis with arthritis in chickens. XVI, 1559
- HENDERSON, James Wedd. Low temperature release of stored energy in cold worked copper. XVI, 1701
- HENNESSEY, JR., John William. A study of some aspects of teaching and learning in a college case-method course in human relations in business. XVI, 1642
- HENNINGSON, Robert Walter. Factors affecting the germicidal property of raw milk. XVI, 1559
- HERKERT, Rev. Charles H. Historical commentary drawn from the *Natural History of Pliny the Elder* for the years 54-76 A.D. XVI, 1677
- HEYTLER, Peter George. Some biochemical characteristics of guinea pig mammary tissue in various functional stages. XVI, 1571
- HILU, Halim Massoud. Inoculation, life cycle and host-parasite relationship of *Septoria tritici* Rob. on triticum species. XVI, 1550
- HINO, Jun. Internal friction and diffusion in alpha brass. XVI, 1656
- HOPP, Ralph Harvey. A study of the problem of complete documentation in science and technology. XVI, 1689
- HOWE, George Marvel. Climates of the North Atlantic. XVI, 1659
- HUGO, Francis Goodale. Conforming behavior in two groups of adolescent children and its relation to certain parental attitudes and personality characteristics. XVI, 1731
- INSELBERG, Edgar. Factors affecting earshoot development in dent corn. XVI, 1572
- JACKSON, Albert Smith. Some aspects of the root locus method applied to the study of linear and nonlinear feedback control systems. XVI, 1651

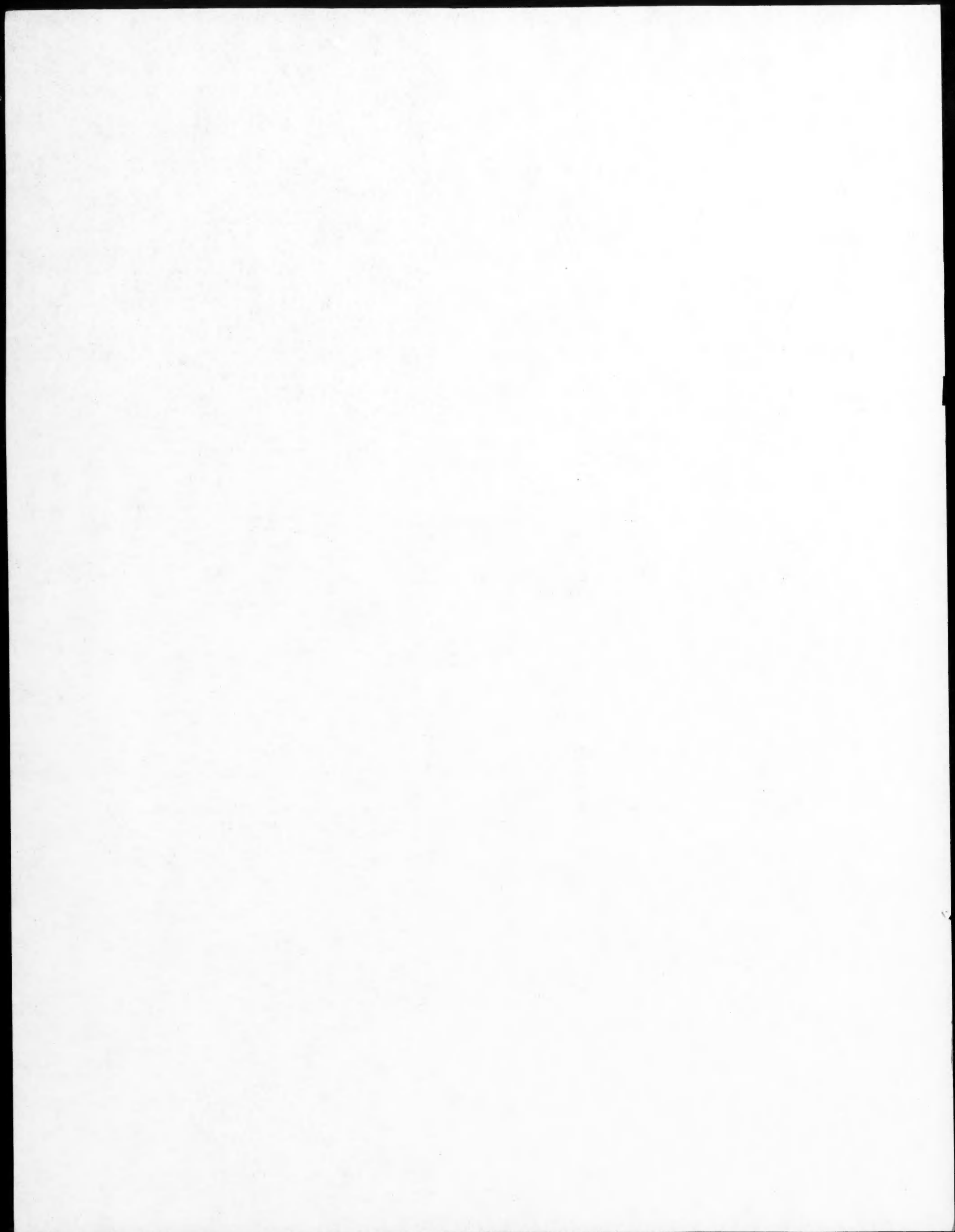
- JACKSON, Ernest Baker. The effects of certain environmental factors on seed production in side-oats grama. XVI, 1550
- JACOB, Alfred B. The Razon de amor, edition and evaluation. XVI, 1683
- JEFFERSON, Frederica Young. Fostering cooperative attitudes in children through an action program. XVI, 1731
- JELLISON, JR., Charles Albert. William Pitt Fessenden, statesman of the middle ground. XVI, 1669
- JOHNSON, Donald Charles. The ambisexuality of the rat ovary as revealed by experiments in parabiosis. XVI, 1742
- JOHNSON, Ogden Carl. Chemical and nutritive changes in thermally oxidized edible fats and oils. XVI, 1657
- JOHNSON, JR., Roger Durgin. Homology regular convergence and local connectedness. XVI, 1693
- JOHNSON, JR., Wiley Carroll. Competition between legume and grass varieties in perennial forage mixtures. XVI, 1551
- JONES, JR., James Graham. A situational analysis of the scope, organizational structure, and function of personnel research in the manufacturing industry. XVI, 1603
- JONES, John Paul. Studies on the auxin levels of healthy and virus infected plants. XVI, 1567
- JONES, Paul Raymond. *ortho*-substituted duryl phenyl ketones: ring closure, metalation, and halogen-metal interconversion. XVI, 1584
- KALLOS, Alexander. The social problem in the work of Anton Wildgans. XVI, 1683
- KANEKO, Thomas M. The catalytic reduction of cobalt from ammoniacal cobalt sulfate solutions. XVI, 1656
- KAPRAL, Frank A. Effects of glucose on the *in vitro* tuberculin reaction. XVI, 1560
- KARRENBROCK, Rodger Edward. A critical analysis of contemporary accounting thought on consolidated reports. XVI, 1604
- KAST, Fremont Ellsworth. Major manufacturing industries in Washington State: changes in their relative importance and causes of change. XVI, 1604
- KATZ, Frank F. The effect of irradiation on reproduction by the heterogenetic generation of *Strongyloides papillosus* (Wedl, 1856) Ransom, 1911. XVI, 1742
- KEIR, Jack Cutler. The liquidity structure of life insurance companies. XVI, 1599
- KENNY, Patrick Joseph. Elastic scattering of 15-Mev neutrons. XVI, 1708
- KERLEE, Donald Duane. A study of nuclear structure through alpha-particle scattering. XVI, 1708
- KESTIGIAN, Michael. Ternary oxide phases of the group IV transition metals. XVI, 1579
- KETCHAM, Roger Gordon. Thiazolo-thiazoles. The reaction of aromatic aldehydes with dithiooxamide. XVI, 1584
- KIDD, Harold Joseph. The morphology of the panicle in the cultivated sorghums. XVI, 1568
- KIPLING, JR., Cecil. Developing a guidebook of professional laboratory experiences for supervising teachers and student-teachers at the University of South Dakota. XVI, 1636
- KLIMAS, Antanas. Primitive Germanic ⁺kuningaz and its spread. XVI, 1678
- KOBAYASHI, Shoshichi. Theory of connections. XVI, 1693
- KOHLBECKER, Eugene Edmund. Asymptotic properties of partitions. XVI, 1694
- KOSS, Walter Eddie. On four parameter families of quadric surfaces. XVI, 1694
- KOTTKE, Roger Harris. I. The action of grignard reagents on *o*-duroylbenzophenone. II. Oxidation of the enol form of 1,2-dimesitylcyclohexane. XVI, 1585
- KOTTWITZ, David A. Indirect magnetic exchange interactions in crystalline oxides. XVI, 1701
- KREER, John Belshaw. Transient response of pseudo-linear feedback control systems. XVI, 1652
- LAGERWERFF, John Vincent. The uptake of ions by excised barley roots from soil-water systems. XVI, 1552
- LANDES, Hugh Stevenson. Temperature dependence of positron lifetimes in solids and liquids. XVI, 1708
- LANDRY, Thomas Ray. Improving reading instruction in the intermediate grades through participation in a specially planned supervisory program. XVI, 1617
- LANGFORD, John Anthony. The amortization of commitments for capital outlay in Connecticut school districts. XVI, 1624
- LATIMER, Paul Henry. Fluorescence and scattering of light by plant pigments. XVI, 1594
- LAWRENCE, Lois Carolyn. Auditory Flutter Fusion as a measure of central effectiveness. XVI, 1724
- LEE, Leon Francis. The place of Keynes in the history of economic theory. XVI, 1612
- LEE, William Allen. Indices of verbal response probability. XVI, 1725
- LEVENBERG, Bruce. A study of precursors, intermediates and an inhibitor involved in reactions of the biosynthesis of purines. XVI, 1572
- LEVIN, Harold Leonard. The micropaleontology of the Oldsmar limestone of Florida. XVI, 1664
- LEVIN, Samuel R. Negative contraction with Old English verbs. XVI, 1679
- LINDER, Irene Christine. Some factors influencing women to choose church-related vocations: a study in occupational sociology. XVI, 1733
- LIU, David Ho-Feng. A study of phase and solubility behavior of tar acids and tar hydrocarbons in liquid propane. XVI, 1648
- LOTT, Peter. The kinetics and mechanism of the thermal decomposition of gaseous methyl isopropyl ketone. XVI, 1595
- LOUGEE, Clara Rom. Climate classification and the practice of irrigation in Norway. XVI, 1659
- LOUGHEED, Virgil Robert. A study of administrative, counseling, and social practices affecting foreign students at an urban university. XVI, 1625
- LOWE, John William. Union security in Florida industries under the Right-to-Work Amendment. XVI, 1600
- LUBIN, John Francis. Clerical and office unionism in the United States: the unit for collective bargaining. XVI, 1600
- LUNDSTROM, Glenn Arthur. Development of teachers' workshops in twenty Nebraska schools. XVI, 1625
- LUSK, Robert C. Principles and practices for the development of sponsored educational materials as exemplified by the educational program of the Automobile Manufacturers Association. XVI, 1618
- LYMAN, Bernard Everett. Vigilance and conditioned avoidance acquisition in the goat: an ethological approach. XVI, 1725
- LYNN, Raymond J. Nucleic acid metabolism of pleuropneumonia-like organisms. XVI, 1560
- LYTLE, JR., Ernest James. The determination of some distributions for which the midrange is an efficient estimator of the mean. XVI, 1695
- MAGEE, Richard Joseph. The enzyme, ascorbic acid oxidase. Experiments with radioactive copper. XVI, 1573
- MAILEY, Everett A. The synthesis of derivatives of alkylated and arylated piperidones for chemotherapeutic studies. XVI, 1586
- MAINORD, Willard Alwin. Experimental repression related to coping and avoidance behaviors in the recall and re-learning of nonsense syllables. XVI, 1719
- MALVIN, Richard Lester. A study of the renal transport mechanisms for inorganic phosphate. XVI, 1712
- MARNER, Gene Ray. Radiometric measurement of 8.7 mm atmospheric attenuation. XVI, 1652
- MARSH, James Donald. A follow-up study of male liberal arts college graduates of Wayne University. XVI, 1626
- MARSHALL, Charles Gridley. Deposition of aerosol particles on screens. XVI, 1648
- MARSHALL, William Harvey. *The Liberal: 1822-1823*. XVI, 1684
- MASUDA, Minoru. Urinary ketosteroid excretion patterns in the adrenogenital syndrome and Cushing's syndrome. XVI, 1573
- McCLENDON, Paul Irving. An experimental study of the relationship between the note-taking practices and listening comprehension of college freshmen during expository lectures. XVI, 1736
- McKIGNEY, John Ignatius. The effect of chlortetracycline (aureomycin) on the pantothenic acid requirements of weanling pigs. XVI, 1548
- McVOY, JR., Kirk Warren. The photo-production of charged pi-mesons from complex nuclei. XVI, 1709
- MEADE, Robert D. Time perception as affected by motivational level, goal distance and rate of progress. XVI, 1726
- MEEK, John Paul. The government and economic development in Indonesia, 1950-1954. XVI, 1601
- MENEFEE, Max Gene. A study of changes in fine structure during development of mammalian embryo epidermis. XVI, 1555
- MICKELSON, Joel C. Attitudes of Americans in France toward contemporary French political life, 1860-1914. XVI, 1684
- MIHAJLOV, Vsevolod. Polarographic investigation of lakes of some hydroxy-anthraquinones. XVI, 1586
- MILLER, Pauline Monz. An experimental study of variability in a wild population of violets. XVI, 1568
- MISEK, Bernard. A study of dispersion with ultrasound. XVI, 1667
- MOE, David Eimon. Ionization by positive ions. XVI, 1705
- MOORE, Thomas Edwin. Evolution of the higher categories of Cercopidae, with a revision of the North American species of *Aphrophora* (Homoptera). XVI, 1743
- MULHOLLAND JR., Thomas Basil. The effect of extraneous auditory stimulation on visual perception. XVI, 1727
- MUNDINGER, Donald Charles. An appraisal of the fiscal autonomy of St. Louis, a home rule city: the St. Louis earnings tax, a case study. XVI, 1715
- MUNEMITSU, Saylo. Endocrine role of rat placenta as revealed by experiments in parabiosis. XVI, 1744
- MURPHY, Preston Vincent. Electrical conduction in a mercury-pumped vacuum system. XVI, 1705
- MURRAY, Lessie Lee. Factors which have influenced the development and success of two selected rural community schools. XVI, 1642

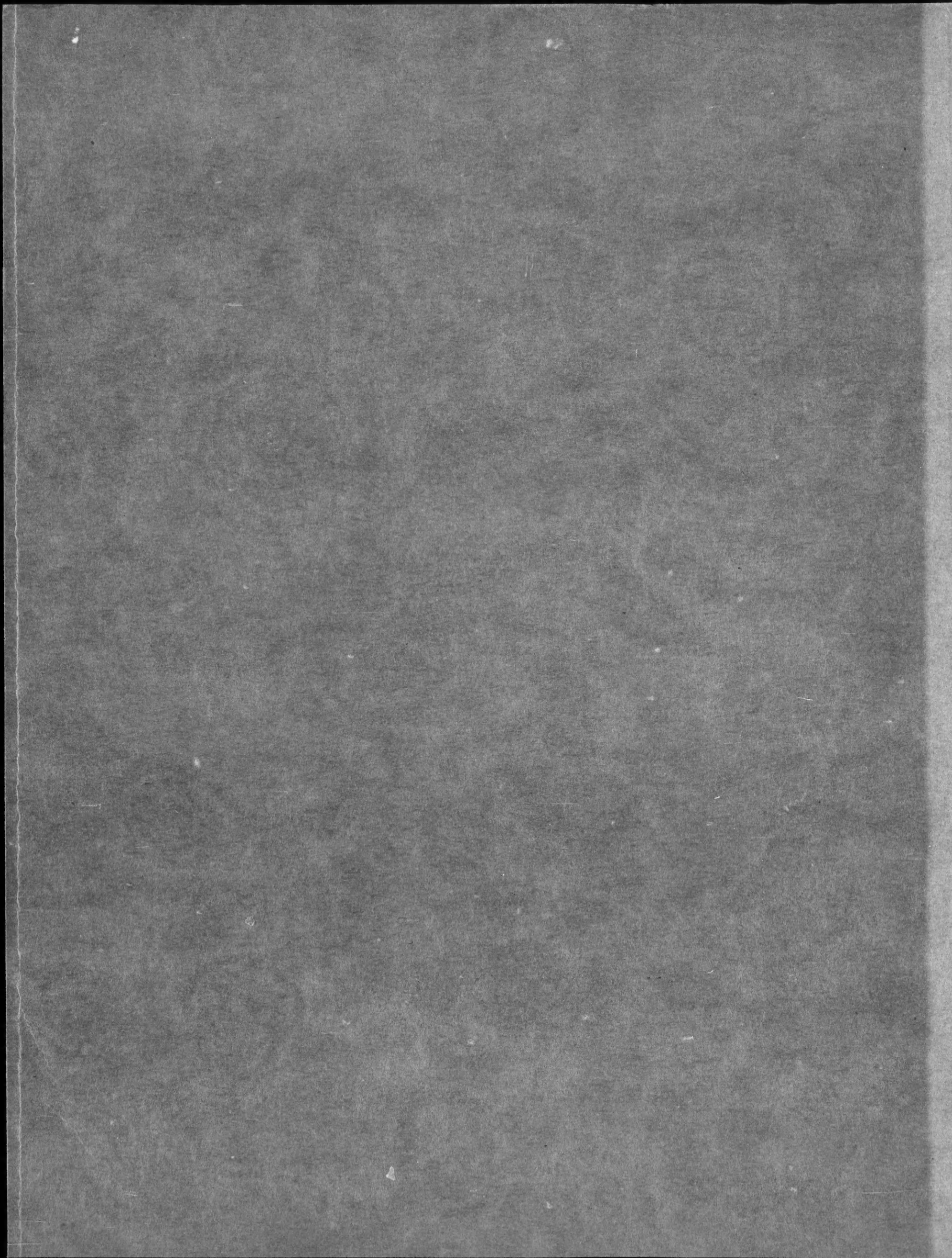
- NAIR, Mohanan Damodaran. Orientation in additions to substituted p-quinonedi-benzimides. XVI, 1587
- NAKSHIAN, Jacob Sarkis. An investigation of the effects of red and green surroundings on behavior. XVI, 1727
- NEWMAN, Robert Preston. A comparison of the ability in formal oral communication of selected liberal arts and engineering students at the University of Pittsburgh. XVI, 1737
- O'DAY, JR., Edward Francis. Differential success of neuropsychiatric patients in predicting the self-ratings of other persons. XVI, 1720
- OGILVIE, Bruce Crossan. Unincorporated urban settlement in Butte County, California: a case study in urban geography. XVI, 1660
- OMIETANSKI, George Michael. The reactions of chloramine with primary, secondary, and tertiary amines in non-aqueous media. XVI, 1579
- ORDWAY, Donald Earl. An aerodynamic theory of a supersonic propeller. XVI, 1646
- ORGEL, Sidney Arthur. Clustering of verbal associates in schizophrenia and chronic brain syndrome. XVI, 1720
- OSBORNE, William Adolphus. Some problems of federation in the British Caribbean. XVI, 1610
- OWENS, Blanche Elizabeth. A film on fundamental procedures in physical education for elementary school classroom teachers. XVI, 1633
- PALMER, Edward Paul. Low-level scintillation counting with application to carbon-14 measurement. XVI, 1709
- PANCOAST, Garfield Sieber. The Second Class Township in Pennsylvania. XVI, 1715
- PARKER, Floyd Gerald. The role of the Nebraska State Department of Education in providing school plant services. XVI, 1627
- PARMENTER, Guy Norris. Glacial water levels in Narragansett Basin and the Blackstone River Valley. XVI, 1660
- PARRY, Carl Eugene. Labor legislation of Michigan, 1909. XVI, 1612
- PATCH, Richard Wilbur. Social implications of the Bolivian agrarian reform. XVI, 1556
- PAYNE, Irving John. Cytological analysis of ultra-violet irradiated *Escherichia coli*: I. Cytology of lysogenic *E. coli* and a non-lysogenic derivative. II. Ultra-violet induction of lysogenic *E. coli*. III. Reactions of a sensitive strain and its resistant mutants. XVI, 1561
- PECK, Nathan Hiram. Evapo-transpiration rates for vegetable crops in New York State and some relationships with climatological data. XVI, 1552
- PEIKERT, Cecilia H. The status of the museum on college and university campuses having accredited schools of education. XVI, 1636
- PENN, James Hubert. Studies on ciliates from mollusks of Iowa. XVI, 1744
- PENTONY, DeVere Edwin. The Marshall Plan: declared objectives and apparent results. XVI, 1717
- PERKINS, Gilbert Thornton. Acid and base catalysis in the solvolysis of alkyl borates. XVI, 1595
- PERRY, Edward Mahlon. The hydrogenation and hydrogenolysis of allylic amines. XVI, 1587
- PETERS, Virginia Briggs. Some quantitative histological studies on the prenatal growth of the liver in the guinea pig. XVI, 1555
- PETERSEN, Frederic E'John. The in-service training of school personnel provided by South Dakota state supported institutions of higher learning. XVI, 1637
- PETERSON, Don Lee. The electron dynamics of the peptide linkage. The polarized spectrum of the myristamide crystal. XVI, 1596
- PETERSON, Wesley J. Population changes in the caecal protozoa of rats and some factors influencing them. XVI, 1744
- PETTUS, William Gower. The production and scattering of polarized electrons. XVI, 1710
- PHILLIPS, Bernard S. A role theory approach to predicting adjustment of the aged in two communities. XVI, 1734
- PICKRELL, Jesse Fredrick. An analysis of group disability insurance. XVI, 1605
- PIRKLE, JR., E. C. Pebble phosphate of Alachua County, Florida. XVI, 1664
- PITTS, Gordon Marshall. The poetry of John Byrne Leicester Warren, Lord De Tabley, exclusive of the dramas. XVI, 1685
- POLK, Charles. The Fresnel region of large aperture antennas. XVI, 1653
- POOLE, Harry Alexander. The unsettled Mr. Cotton. XVI, 1670
- PORTER, Lorena Ray. Construction of a film as an aid for teachers of primary physical education. XVI, 1633
- PORTER, Roger Stephen. Some chemical properties of trifluoromethyl hypofluorite. XVI, 1579
- POWELL, Arnet Lauriston. The properties of electrolytes in anisole-nitrobenzene solutions. XVI, 1596
- PRESS, Newtol. Electron microscope study of the plant cell with special reference to the osmiophilic platelet. XVI, 1569
- PRICE, Justin Jesse. I. Some duality theorems II. On the characters of certain compact abelian groups. XVI, 1695
- PRINCE, Herbert Norman. Some nutritional needs and metabolic activities of selected flavobacteria. XVI, 1562
- RAEFF, Lillian Gottesman. The effect of literal and poetic orientations on the meaning structure of words. XVI, 1728
- RALPH, Kathryn Magaw. Selective recall of completed and incomplete tasks as a function of age and instructions. XVI, 1728
- RAPP, Oliver LaVerne. Military problems facing high school boys. XVI, 1628
- RAY, James Thomas. A study of adaptation to tilt. XVI, 1729
- READ, Merrill Stafford. The effect of hormones on the intermediary metabolism of mammary glands. XVI, 1574
- REDFIELD, Maynard Gregg. Some social and intellectual influences in the development of public education in Missouri 1865 to 1900. XVI, 1630
- RESNICK, Lawrence. H. H. Price's analysis of the nature of concepts. XVI, 1698
- ROBERTS, Theodore Harold. Synthesis and reactions of epoxides in the cyclopentane and cyclohexane series. XVI, 1588
- ROBINSON, Joseph Dewey. Molecular orbital studies of chlorine substituted methanes. XVI, 1597
- ROEMER, Spencer John. A survey of the status of pupil personnel services in selected schools in New York State. XVI, 1619
- ROGERS, Ralph L. Preparation of benzimidazolyl and pyridimidazolyl alpha amino acids. XVI, 1588
- ROGERS, William Irvine. Partially hydrolyzed ribonuclease with enzymatic activity. XVI, 1575
- ROSA, Richard John. Part One: Shock wave spectroscopy. Part Two: Engineering magneto-hydrodynamics. XVI, 1701
- ROSENBLATT, Bernard Philip. The influence of affective states upon the body-image and upon the perceptual organization of external space. XVI, 1721
- ROTH, William. The preparation, partial purification, and application of a cellulase from *Myrothecium verrucaria*. XVI, 1591
- RUDWICK, Elliott Morton. W. E. B. Du Bois: a study in minority group leadership. XVI, 1734
- RUMI, Gian-Carlo. VHF radar echoes associated with atmospheric phenomena. XVI, 1702
- RUNDLE, Marjorie Arnold. The concept of the lady in the American novel, 1850-1900. XVI, 1674
- RYDEN, Fred Ward. A study of the vaccinia virus in stable strains of tissue cells cultivated *in vitro*. XVI, 1562
- SAGAWA, Yoneo. The production of polyploid forms in the Easter lily, *Lilium longiflorum* variety *giganteum* Hort., with special reference to triploids. XVI, 1564
- SAPIENZA, Samuel R. The Western Hemisphere Trade Corporation Act and its implementation—a facet of United States foreign commercial policy. XVI, 1605
- SAYYAB, Abdullah Shakir. Cretaceous Ostracoda from the Persian Gulf area. XVI, 1665
- SCHIFF, Jerome A. Preliminary studies on the sulfur metabolism of *Chlorella pyrenoidosa* with sulfur-35. XVI, 1575
- SCHLESS, Howard H. Chaucer and Dante: a revaluation. XVI, 1675
- SCHMALSTIEG, William R. Criteria for the determination of Slavic borrowings in Lithuanian. XVI, 1680
- SCHMIDLIN, Frederick William. Pairwise correlations in the many-body problem. XVI, 1703
- SCHROEDER, Pearl. Conceptual flexibility in grouping behavior. XVI, 1729
- SEEMANN, Karl William. The photoelectric cross section of lead for 0.511 Mev gamma-rays. XVI, 1710
- SHAFFER, Dwight Thomas. Analysis of certain factors in the high school preparation of Iowa high school graduates entering selected Iowa colleges. XVI, 1620
- SHERMAN, Douglas Roland. The emerging role of vocational-terminal education in the public community colleges of Michigan. XVI, 1628
- SHIMADA, Bell Masayuki. A study of changes in fishing effort, abundance, and yield for yellowfin and skipjack tunas in the Eastern Tropical Pacific Ocean. XVI, 1565
- SHIPLEY, JR., Thomas E. Threat to the self, the direction and breadth of attention, and the distance gradient. XVI, 1730
- SHOUMAN, Ahmad Raafat. Model study of heat transfer in panel heated spaces. XVI, 1654
- SIEGEL, Helene Freud. A study of teachers' use of business-sponsored instructional materials in selected elementary schools. XVI, 1643
- SINGER, Jerome Ralph. Antiferromagnetism in single crystals of NiO and CoO—an investigation by means of susceptibility measurements. XVI, 1703
- SKALBECK, Oliver M. The relationship of expectancy of stuttering to certain other designated variables associated with stuttering. XVI, 1738
- SLACK, Glen Alfred. Thermal conductivity of potassium chloride crystals containing calcium. XVI, 1704
- SNOW, Phyllis Roberta. Managerial aspects of freezer use with emphasis on cooked and prepared foods. XVI, 1672

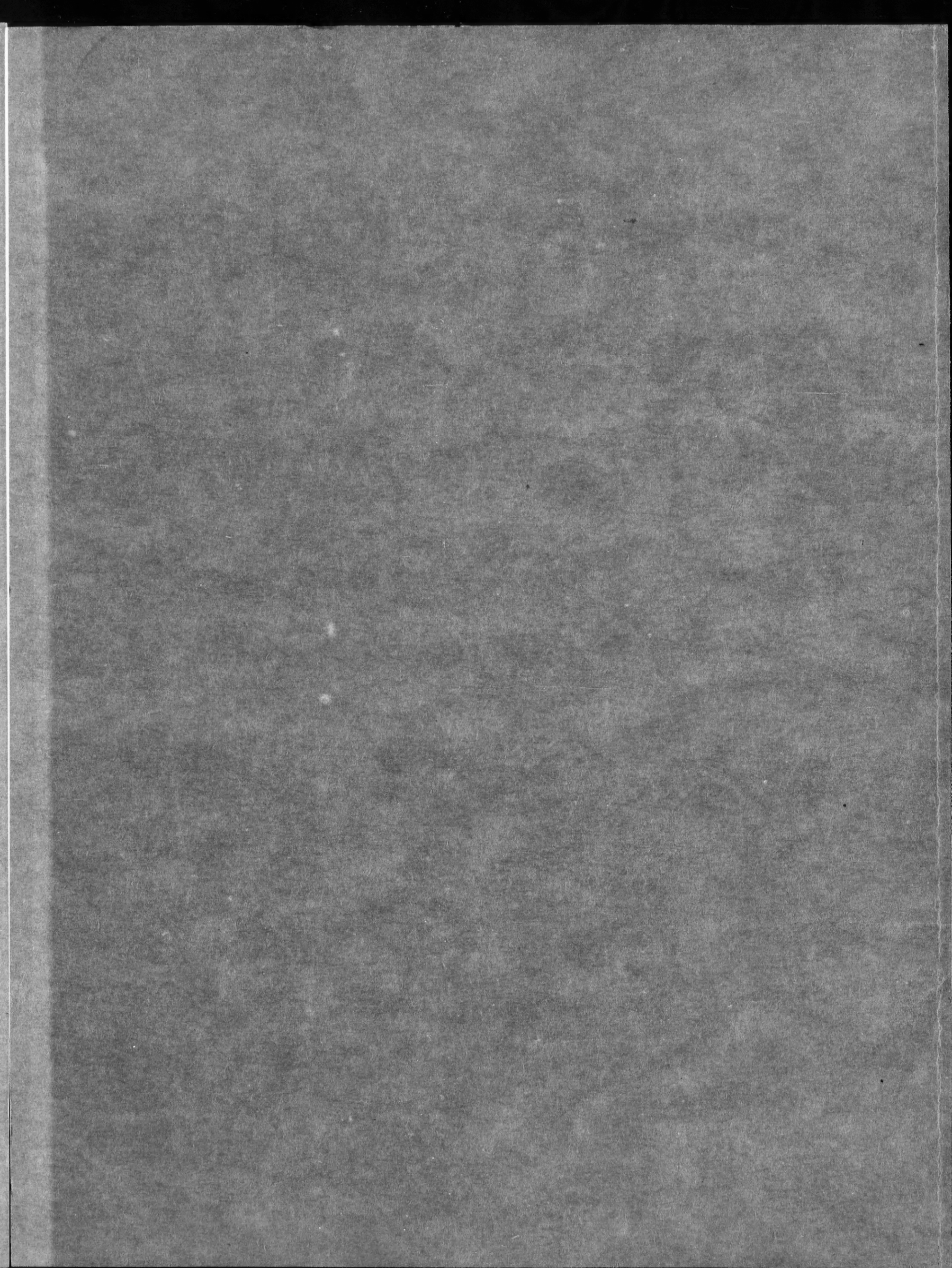
AUTHOR INDEX

1751

- SOMERVILLE, Don Smith. A study of local regulations and group actions on the circulation of newsstand publications. XVI, 1673
- SORENSEN, Lazern Otto. Effects of maleic hydrazide on photosynthesis and respiration of red kidney bean. XVI, 1569
- SPAETH, Harold J. The background of private rights and American constitutional development. XVI, 1716
- SPANDORFER, Lester Malvern. Automatic electronic telephone switching systems. XVI, 1653
- SPROWLES JR., Harry D. The search for Thomas Wolfe: with particular stress upon the meaning of the amatory theme. XVI, 1686
- STANMYER, JR., Joseph LeRoy. Studies in medicinal chemistry. The preparation of 2-(dialkylaminoalkylamino)diphenyl sulfides. XVI, 1589
- STEINER, Russell Irwin. Influence of steric factors in aminations of allylic chlorides. XVI, 1589
- STELLY, Randall. An economic study of agrarian problems in Indochina. XVI, 1545
- STEPHENS, Robert Lawrence. Studies on the metabolism of riboflavin in *Ashbya gossypii*. XVI, 1575
- STERN, Bernard Saul. American views of India and Indians, 1857-1900. XVI, 1671
- STERNBERG, Hilgard O'Reilly. A contribution to the geomorphology of the False River area, Louisiana. XVI, 1661
- STOCKTON, Robert Stansbury. Wage surveys and wage policies of Ohio manufacturers (Volumes I and II). XVI, 1606
- STOJANOVIC, Borislav Jovan. Microbiological mineralization and immobilization of soil nitrogen. XVI, 1545
- STRANGE, Harold O. Interaction of inorganic macromolecular systems with surface active agents. XVI, 1597
- STROMSTA, Courtney Paul. A methodology related to the determination of the phase angle of bone-conducted speech sound energy of stutterers and non-stutterers. XVI, 1738
- STRONG, Rudolph Greer. Control of the six-spotted leafhopper, *Macrosteles fascifrons* (Stal), a vector of lettuce-yellows virus. XVI, 1745
- SWEETSER, Franklin Pratt. The University of Pennsylvania manuscript of the Old French *Blancandin et l'Orgueilleuse d'amour* with a study of the manuscript relations. XVI, 1675
- TAYLOR, James William. The agricultural settlement succession in the prairies of southwest Louisiana. XVI, 1661
- TAYLOR, Robert Martin. International mail flows: a geographic analysis relating volume of mail to certain characteristics of postal countries. XVI, 1662
- TEWELL, Fred. A study of the channels of communication used by one hundred Negroes in Baton Rouge, Louisiana. XVI, 1739
- THOMPSON, Joseph Wilmer. An economic history of the Mesabi Division of the Great Northern Railway Company to 1915. XVI, 1612
- THORNBURG, Robert B. A survey of sixteenth-century English religious verse. XVI, 1686
- THURSTON, Gaylen Aubrey. Bending and vibration of skew clamped plates. XVI, 1655
- TICHANE, Robert Myron. Complex formation of metal ions with congeners of iminodiacetic acid. XVI, 1580
- TINKLE, Donald Ward. The systematics and ecology of the *Sternotherus carinatus* complex (Testudinata: Chelydridae). XVI, 1745
- TORNWALL, William Allen. Studies in Chaucer's imagery. XVI, 1676
- ÜBERALL, Herbert. A high energy interference effect of bremsstrahlung and pair production in crystals. XVI, 1710
- VALADE, William James Adrian. A study of the origin, development, and trends of selected community colleges of Michigan. XVI, 1629
- VANDERHEIDEN, Bernardo Sanchez. Isolation and properties of yeast aldolase. XVI, 1576
- VARMA, Kripa Nath. Population problems in the Ganges Valley. XVI, 1663
- WALTON, Dean Kirkland. The decomposition of formic acid vapor on evaporated nickel films. XVI, 1598
- WATERS, Harold Arthur. Claudel And The City Of Men. XVI, 1687
- WATSON, Ben E. M. The effects of cortisone and adrenalectomy on the growth rate of the Ehrlich mouse ascites tumor. XVI, 1556
- WATSON, JR., Simeon Elisha. Statistical optimization of sampled-data control systems operating in the presence of random noise. XVI, 1653
- WEBB, George Willis. The resources of the Cumberland Plateau as exemplified by Cumberland County, Tennessee: a geographic analysis. XVI, 1663
- WEGENER, Adolph H. The death problem in the works of Ernst Wiechert. XVI, 1688
- WEINBERG, Alan Edward. The decomposition of 5-substituted 3-nitroso-2-oxazolones. XVI, 1590
- WILEY, Selva Carter. The industrial geography of the Kanawha Valley. XVI, 1664
- WILLIG, Leslie August. Student employment offices of the universities of the Western Conference. XVI, 1607
- WINGATE, Marcel Edward. An experimental investigation of the effect produced by calling attention to stuttering. XVI, 1722
- WITKIN, Arthur Aaron. The prediction of potentials for effectiveness in certain occupations within the sales field. XVI, 1718
- WOLBERS, Charles Paul. Electromyographic study relative to movements of thigh at hip joint. XVI, 1634
- WOODS, Harvey Smith. An economic analysis of the organization and operation of a sample of southern Illinois farms which maintain beef cow herds. XVI, 1546
- WYATT, R C. The symbolism of color in the drama of German expressionism. XVI, 1688
- WYLIE, Joyce Fyfe. Karl Mannheim's social theory and concept of education. XVI, 1643
- YARBOROUGH, Legrand Iris. A history of the early teaching of agriculture in South Carolina. XVI, 1631
- YOS, Jerrold Moore. A study of the specificity of the London-van der Waals dispersion force in molecular aggregates. XVI, 1704
- YOUNG, Milton Abraham. Academic requirements of jobs held by the educable mentally retarded in the State of Connecticut. XVI, 1620
- YOUNG, Stanley. Grievance arbitration in the anthracite industry. XVI, 1601
- ZIEGLER, Donald Jenks. Proportional representation in the social and political conflict in Germany, 1871-1920. XVI, 1671
- ZOLL, III, Allen Alderson. An investigation of employee economic education by businessmen, with an evaluation of the treatment of content in selected materials. XVI, 1607
- ZUKOWSKI, Walter Henry. The Panama Canal: a public venture. XVI, 1611







DISSERTATION ABSTRACTS

Volume XVI, No. 10

1956